The Veterinary Record

FOUNDED BY WILLIAM HUNTING, F.R.C.V.S., 1888.

No. 15. APRIL 15, 1933. Vol. XIII.

COMPARATIVE PATHOLOGY OF HELMINTHS*

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Introduction

All worms live more or less at the expense of their host. Some make small demands on his hospitality other than food, warmth and disposal of excreta. Others make heavy demands and feed on his tissues. As a rule, however, sexually mature parasites, unless present in very large numbers (as so frequently happens under modern agricultural conditions) do comparatively little individual harm—except accidentally, as when an Ascaris blocks the bile duct or a liver fluke introduces a sporulating anærobe. Such forms as live their asexual life in a mammal are not so careful, however, and extensive damage often occurs, *e.g.*, hydatid, gid, larval Trichinella and so on. When the adult parasite finds itself in an abnormal host also, extensive damage may occur (*e.g.*, dog hookworms in man): and this tends to be true also if the host is very young, or, less frequent, if old.

We are concerned here mainly with what one may term normal pathology—the normal reaction of the host to the presence of a foreign body. Two factors, of course, are involved—the species of the host and the nature of the foreign body. The natural defences of an animal are by no means the same for all species of animal. We can see this plainly if we consider the comparative pathology of a bacterial infection, such as tuberculosis, and study the different type of reactions displayed by cattle, sheep, horses, pigs, dogs, or man, to the same organism. We can study this equally well in a helminthic infection, such as liver fluke disease or hydatid cyst. This is a subject which has received too little attention from the pathologists; however, we *can* definitely state that the type of host-reaction to a foreign body differs to some extent with the species of host. The second factor is the worm itself and we may spend a little time considering the subject from the point of view of the helminth.

Unfortunately parasitic worms form an *economic*, not a *natural* group—and include several phyla which are related only by habitat. The two most important of these are the flatworms and the round-worms and it will be necessary to discuss each separately.

* An address (illustrated by lantern slides) delivered before the Central Veterinary Association of Canada, at Ottawa, February 22nd, 1933.

FLATWORMS

The flatworms (*e.g.*, the flukes and the tapeworms) are animals provided with a more or less solid body in which are embedded the various organs. The surface is covered with a thick cuticle which is often provided with spines and suckers for maintaining the animal in position in the host. The flukes have a digestive system (without, however, possessing an anus) while the cestodes feed by osmosis. All possess a simple excretory system discharging at the posterior end of the body, and all lay eggs. So far as we know, that, together with their actual movements, constitutes the entire apparatus of the adult flatworms for the production of potential damage in the host. The larvæ are rather different and may possess, in the case of the flukes, piercing and other organs for obtaining entrance to the body, and in the case of the cestodes, the power of passively forming cysts which may cause an enormous pressure on some of the host organs.

Accordingly, flatworms may damage the host in the following ways:—

(1) By abstracting food or salts from the food of the host and thereby depriving him of some essential substances, *e.g.*, tapeworms have large calcium requirements.

(2) By producing an intoxication from excreted fluids (shown by blood and other changes), or, in the case of the flukes, regurgitated undigested food, possibly mixed with their own digestive secretions, (*e.g.*, iron pigment in the case of the Bilharzia worms.

(3) By mechanical damage from suckers, hooks or spines, (*e.g.*, tapeworms and Fasciola).

(4) By passive obstruction (*e.g.*, tapeworms in sheep).

(5) By the production of larval cysts (*e.g.*, hydatid).

(6) By the production of special secretions in the case of larval flukes and their migrations.

Some Important Flatworms and their Pathology

CESTODES

Although adult cestodes are relatively harmless, they may do damage in several ways:—

(*a*) Their suckers and hooks mechanically break and destroy the epithelium of the

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intestine and compress the propria mucosæ. The rostellum of certain tapeworms (*e.g.*, Dipylidium) is able to break through the epithelium and may be found in the fundus of a gland. If the worm remains fixed for some time at one spot, there is often an inflammatory reaction. This is well seen in the case of *Anaplocephala perfoliata* in the large intestine of the horse, where serious ulcers result, often thickened by a proliferation of the connective tissue. Microbes occur on the fixation organs and these are applied to the inflamed tissue or inoculated with the hooks. The result depends on the pathogenicity of the microbe. The importance of the worm lies in the fact that it can attack absolutely healthy tissue. If the parasite changes position frequently, inflammation and ulcer formation are usually absent.

(*b*) Cestodes have quite large calcium requirements, and when the diet is low in calcium, they may remove so much that the host suffers from an actual calcium deficiency. It is improbable that their other metabolic activities cause any great harm, although it is believed that some (*e.g.*, *T. crassicolis* of the cat) actually secrete a "toxin."

(*c*) Only two cestodes in the domestic mammals live as adults outside of the intestine. These two (*Stilesia hepatica* and *Thysanosoma actinoides*) live in the oile-ducts and cause lesions analogous to those produced by liver flukes.

(*d*) Cestodes are of their greatest importance in their larval stages. This is particularly true of the genus *Tænia* and its very close relation *Echinococcus*. *Tænia* produces cysticerci and cœnuri in numerous herbivorous animals, while *Echinococcus* is the cause of hydatid cyst.

Hydatid Cyst.

The hydatid cyst is the larval stage of *Echinococcus granulosus*, the minute tapeworm found in the intestine of dogs, foxes and other carnivores. The egg, passed in the droppings of the fox or dog, is swallowed by the intermediate host—and practically any species of mammal can serve as an intermediate host. In the intestine the larva emerges from the egg and, boring its way through the wall of the intestine, is carried by the blood stream to the liver; if it is not retained by that organ, it passes on to the lungs. There it becomes vesicular, develops externally a strong laminated cuticle, and internally, a crop of brood capsules, each of which contains a number of small tapeworm heads.

The presence of the cyst in the liver or lungs provokes a pronounced fibrous reaction with an accumulation of leucocytes—mostly eosinophiles—and an adventitious cyst is formed. In the typical cyst the parasite and the host reaction develop simultaneously and the resulting shape is more or less spherical. When the cyst grows more rapidly than usual and where there is a variable peripheral resistance (due to the presence of bronchi, bile-ducts, blood vessels, and so on) pouches are formed and it is often called a "multilocular cyst." Where, however, the host reaction gains the supremacy, the original cyst becomes broken up into a number of small cysts separated by thick fibrous stromata and is often referred to as multicystic. Often, of course, the host gains the supremacy at an early stage of development and the parasite never develops. Other variations are found, but all are manifestations of the same parasite; the reaction of the host is the variable factor.

The ideal host for the cyst is the sheep and the lung is as frequently affected as the liver. All three types are encountered in the lungs, the most frequent being the fertile pouched or simple cyst; the multicystic form is rare. In the ox, the lung is more frequently affected than is the liver; but the commonest form seen is a small, *sterile*, simple cyst, with a poorly-developed cyst membrane and adventitia. Larger simple and multilocular cysts (both types being fertile) do occur, but their incidence is low. Multicystic forms usually occur in the liver. In the pig, the lung is less frequently infected than the liver and the simple, unilocular cyst is the commonest form seen. This is also true of horses.

The factor deciding the final habitat of the cyst appears to be an anatomical one—the diameter of the blood capillaries. Where these are relatively narrow, it stays in the liver; where they are wider, it passes on to the lungs. Only a very small percentage succeed in passing beyond this.

TREMATODES

While adult paramphistomes are to all intents and purposes non-pathogenic, they are far from non-pathogenic in their immature stages, when they are living in the small intestine—especially the duodenum. They cause a pronounced thickening of the mucosa and an enlargement of the blood capillaries. Their effects are not merely local, as they produce an anæmia, fatty changes in the liver and a general fat necrosis. The calcium content of the blood is reduced.

As the worms become mature (about six to eight weeks after infection) they migrate forward to their permanent habitat in the rumen and reticulum: some forms invade the bile-ducts, but nothing is known of their pathogenicity there.

The trematodes invading the liver produce much the same results in all species. The most important parasite is *Fasciola hepatica*, the young forms of which mainly reach the liver from the abdominal cavity. The invasion of the

liver is accompanied accordingly by a certain amount of hæmorrhage. As the flukes grow they stimulate the liver, if present in moderate numbers, to increased activity and it is during this period that the animal often puts on " condition." If the invasion is heavy, however, the destruction at this stage, combined with the hæmorrhage, may result in death. The liver fluke feeds on blood and bile as it grows, but any loss from this source is generally easily replaced by the host. It lives in the bile-ducts and as its cuticle is covered with minute spines, it is a continual source of irritation there and their walls become sclerotic and cystic enlargements may occur with the deposition of calcium in the walls. As the source of irritation is a helminth, there is the usual eosinophilia, both locally and in the blood. The intoxication which is responsible for the eosinophilia also causes an anæmia. Partly by the action of this toxic substance and partly from the continual irritation, there is a hypertrophy of the biliary epithelium and it may become adenomatous. If the number of flukes is very large, there may, however, be erosion and atrophy of the mucosa.

The final picture depends to a considerable extent on the number of flukes present. When the numbers are small, there is a cystic enlargement of the bile-ducts, adenomata of the epithelial lining, invasion with eosinophiles and other leucocytes, and the eventual development of scar tissue round the ducts, with the characteristic appearance of " pipe-stems " which may become confluent owing to increase in size. When the infection is severe, the epithelium is eroded and the worms invade the parenchyma, forming abscesses from which eggs are infiltrated into the surrounding tissue. Ultimately large tracts of the liver are replaced by fibrous tissue with pressure atrophy of the portal vessels. Calcium salts are deposited in the walls of the enlarged bile-ducts, which contain flukes surrounded by a thick bile filled with eggs.

The flukes destroy a number of blood-cells, as well as obstructing the ducts, thereby causing cystic enlargements and general icterus. The pressure atrophy causes a cirrhosis, with accompanying ascites and splenic hypertrophy. The most profound general effect, however, appears to be due to a specific toxin secreted by the flukes, causing a more or less profound anæmia, which is accompanied by a thrombocytosis and an eosinophilia which may be as high as 60 per cent.

Opisthorchis lives in the distal capillaries of the biliary passages, particularly in the left lobe of the liver, of fish-eating animals. The loss of blood and the blocking of the ducts is relatively uncommon and general icterus is seldom seen. Its presence causes a marked proliferation of the biliary epithelium with the production of crypts and new biliary capillaries. There is the usual formation of new fibrous tissue round the ducts and extruded eggs; but giant cells are not seen. Toxæmia appears to be relatively slight. Slight infections cause proliferation of the biliary epithelium with gradual thickening of the walls and infiltration with leucocytes. Heavier infections cause pronounced thickening of the walls with pressure on the adjacent parenchyma causing a fatty degeneration and vacuolation of the liver cells. Massive infection produces a generalised cirrhosis with complete destruction of the liver cells and obliteration of the vessels. In heavy infections, the pancreas may be invaded.

Dicrocœlium in herbivores and its relations in carnivores produce much the same picture.

Paragonimus produces cysts in the lung, each cyst generally containing two flukes and a quantity of rusty fluid filled with ova. In carnivores the cysts seem to have resulted from the hypertrophy of small bronchioles. The cylindrical epithelium becomes transformed into a stratified pavement epithelium. Outside this is a sclerotic wall infiltrated with leucocytes, including mast-cells and giant-cells. Eggs also are often found in the lung tissue, causing a local cirrhosis with a rusty appearance due to their colour. Pseudo-tubercles are often seen.

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ROUNDWORMS

The roundworms have an entirely different morphology and mode of life. The sexes are separate and each animal consists of a set of tubes fitting inside a tubular cuticle. This cuticle is a semi-permeable membrane and may be provided with spines and teeth to assist in feeding or maintaining in position. It possesses a number of openings. The digestive tube opens at an anterior mouth and a posterior anus by which waste material is passed into the host. The anterior end of the digestive tube is a more or less muscular sucking organ—the œsophagus—containing three salivary glands—one discharging into the mouth and the other two into the lumen of the canal. The degree of development of these glands varies greatly in different species. Their cytoplasm is rich in glycogen and various granules of an unknown chemical composition. The actual nature of the secretion is unknown; but, at least partly, it causes liquefaction of the tissue that is being ingested.

At about the level of the œsophagus, there is found a pore on the cuticle called the " excretory pore ": this is associated with two peculiar organs—a pair of large unicellular glands, and a pair of tubes which lie in, or near, the lateral lines of the body, for its entire length. The glands, for convenience, are called the cervical glands, but their function is unknown—it is almost certainly secretory and may be salivary. The tubules are usually called excretory tubules, but their function also is unknown—it is almost

certainly not excretory, as excretion is mainly performed through the cuticle.

Near the mouth another pair of glands—the cephalic glands—opens, and here again, the function is unknown.

The female nematodes produce eggs or larvæ and excrete a uterine fluid of unknown composition. Both sexes are very muscular and capable of very active movements. The larvæ of the nematodes are essentially similar to the adults but are much smaller in size and without sexual organs. Roundworms may accordingly injure the host in the following ways:—

(1) By using food or other material necessary for the well-being of the host. We know very little about the food of roundworms yet. Some feed on mucous membrane, others on blood; some feed on bacteria, vegetable material, gut ciliates or even other smaller worms. We know even less about the disposal of that food during and after digestion.

(2) By the production of secretions, some used in digestion, others possibly intended for other purposes. These secretions may come from the œsophageal, cephalic or cervical glands and some have been shown to be hæmolytic, histolytic or anticoagulant in action.

(3) By the production of excretory products through the skin or from the anus.

(4) By mechanical destruction of tissue or blockage of ducts.

(5) By the migrations of larvæ, either through the skin, the intestine or within the body.

Some Important Roundworms and their Pathology

ASCARID WORMS

In the alimentary tract the larva emerges from the embryonated egg which has been swallowed with the food, and bores through the gut wall into the blood stream. It is carried by the blood to the liver, and after a short sojourn there passes on, *via* the heart, to the lungs. During this journey, which takes from four to six days, it has increased greatly in size and is too large to pass through the blood capillaries of the lungs. It ruptures them and generally escaping into the alveoli, reaches the bronchi and is mechanically carried up the trachea, to be swallowed. On its second arrival in the intestine it remains there and in a month or so has become sexually mature. Not all the larvæ escape from the lungs, however, and some are carried on by the blood circulation to various other organs of the body. We have no knowledge of how, or on what, the adults feed. Blood does not occur in the intestine but it is interesting to note that quite a variety of bacteria are found there as well as on the skin.

The damage done by the adult is usually so slight as to be indetectable, but the larvæ can cause the production of serious lesions in the liver, lungs and kidneys.

They damage the hepatic parenchyma to such an extent that all stages of degeneration from cloudy swelling to actual necrosis are encountered, especially around the intralobular vein. Eosinophiles and mononuclears tend to occur in clusters at the periphery of the lobules as well as scattered throughout the whole tissue. Often this reaction is relatively very slight around the larvæ and it is probably of the nature of a regenerative process. A certain amount of mechanical damage is done, but on the whole it is mainly "toxic." Sometimes the larva is killed by the host-reaction, encapsulated and caseated or calcified.

In the kidneys, the damage is almost entirely "toxic" and affects the cells of the tubules, especially in the portion between the loop of Henle and the end of the junctional tubule. Necrotic changes are seen in the cells, and casts and débris are found in the lumina. Larvæ are only occasionally seen in this situation.

In the lungs the actual damage done by the larvæ is considerable and consists essentially of intra-alveolar hæmorrhage and œdema. The blood cells and the alveolar epithelial cells are shed into the alveoli and are phagocytosed by mononuclears which become pigmented. Cell clusters similar to those seen in the liver are less frequent, but larvæ are often found in their midst. While the larvæ do not, it is true, cause a true broncho- or lobar-pneumonia, the traumatic and "toxic" damage renders the lungs highly susceptible to bacterial invasion.

During the stay in the liver there is a definite immunity response to the larvæ which can be demonstrated by complement fixation tests. The host appears to become sensitized by the larvæ during this period and after the first week, when the larvæ migrate to the lungs, there may be an extensive exudative reaction giving rise to pneumonia. There is a proliferation and infiltration of inflammatory cells—mostly histiocytes and eosinophiles—œdema and hæmorrhage: this reaction is mainly localised around the larvæ.

THE BLOOD-SUCKING STRONGLYES

In the group of nematodes provided with mouth capsules (*e.g.*, the sclerostomes in equines and the hookworms and their allies in other domesticated animals) the capsule is pressed against the mucous membrane of the intestine and a portion of the tissue is sucked in. Owing to the shape of the capsule, the plug of tissue is strangulated at the base and the worm is enabled to attach itself securely. The sucking action partly draws the elements of the mucosa apart, with a consequent infiltration of round cells (lymphocytes and eosinophiles) into the neigh-

bourhood and an increase of mucus. The œsophageal gland secretion has a histolytic action on the tissue swallowed and it gradually becomes necrotic and predigested. The nuclei are pyknotic and the protoplasm filled with fine granules. Occasionally blood vessels are ruptured and blood is ingested with the tissue: this is more frequent in some species of worms than in others and we may suppose that the site of attachment is, to some extent, deliberate. When the plug of tissue is digested, the worm changes to a fresh spot, leaving a denuded spot, which is not only functionless, but provides an entry for bacteria or toxins.

The sclerostomes of horses produce small ulcerations on the large intestine and seem to select spots where blood can be easily obtained. A special case is *Triodontophorus tenuicollis*. Here several hundreds of worms may be found on the same spot of the wall of the right dorsal colon, usually on the course of the dorsal artery, causing an extensive ulcer, several centimetres in diameter. Microbes are rare in these ulcers and they are undoubtedly caused by the mass action of hundreds of parasites.

In species provided with leaf-crowns surrounding the mouth opening, the small vessels at the point of attachment are often engorged. This is true also of the true hookworms.

The asexual adults of *S. vulgaris* are often found in "aneurisms" in the mesenteric artery and other visceral branches of the aorta. The aneurism is caused by the larva fixing itself on the intima of the artery and causing an hypertrophy of the three arterial layers. It is not an aneurism in the usual meaning of the word—rather a hyperplasia. The effect is the same, however, because it completely obliterates the lumen and a blood clot ultimately forms, with degeneration of the local nerve trunks from pressure atrophy and chronic inflammation. This, rather than the aneurism, may be the cause of the colic which is so frequently produced in colts. The severity of this condition suggests that it is accidental: and Olt has recently claimed that it is not a normal part of the life cycle.

Hæmonchus contortus is the large red worm so commonly found in the abomasum and duodenum of domestic ruminants. Its effect on sheep has recently been demonstrated in some detail by Fourie in South Africa. He finds that the worms ingest blood and cause hæmorrhage into the abomasum and that this is the cause of the anæmia associated with the disease. The hæmorrhage probably stimulates an initial polycythæmia or, more particularly, an erythrocytosis: this is followed by exhaustion of the blood-forming organs, and the early increase in the colour index is succeeded by a decrease. He found that no lesions which could be regarded as specific were present. The blood picture closely resembles pernicious anæmia, but the lesions are somewhat different. The anæmia disturbs the fat metabolism and this, as well as circulatory and nutritional disturbances, produces a necrosis round the central veins of the liver, with the deposition of fatty substances and crystals in the liver cells. Icterus and hæmoglobinuria are both absent, as there is no hæmolysis of the red cells.

The abomasal contents are often brown in colour from hæmoglobin and the small intestine often becomes "dropsical." I have recently examined some of these intestines in pure Hæmonchus infections. The dropsical appearance, however, is due to an enormous hypertrophy in the submucosal glands, which suggests that some toxic substance is secreted by the parasite.

Most of the intestinal nematodes of sheep and their relations are not blood suckers, however; in fact, only one other common genus—*Nematodirus*—ever seems to contain blood in its intestine.

Some small species, such as *Ostertagia ostertagi*, enter the glands of the abomasum and mechanically widen them. The worm rolls into a spiral and a small nodule is formed by the enlarged gland. In the others, however, we are still ignorant of their method of producing disease.

LUNGWORMS

Quite a number of helminths occur in the lungs of mammals. We have already mentioned Paragonimus, hydatid cysts and Ascarid larvæ. The most important are a group of nematodes, however, called the Metastrongyles. Some of these live in the larger air tubes while others inhabit the alveoli, parenchyma or even the pulmonary blood vessels. Their pathology varies accordingly.

Dictyocaulus and *Metastrongylus* live in the bronchi of herbivores and of pigs respectively and are the most dangerous of the lungworms in stock. When numerous they occlude the bronchi and mechanically interfere with breathing. Their presence irritates the bronchial mucosa, giving rise to an inflamed and catarrhal condition, with proliferation of the epithelial cells and the production of fibrous tissue: the inflammation may extend to the adjoining parenchyma, causing a typical peribronchitis. The exudate, consisting of a blood-stained mucus containing exfoliated epithelial cells, eggs, larvæ and leucocytes, especially eosinophiles and polymorphs, not only assists in the occlusion, but passes backwards to the smaller bronchioles and alveoli. There it causes a localised catarrhal or interstitial pneumonia. In this way, considerable areas of lung may be rendered functionless without the aid of bacteria. Atalectasis may occur as the result of the occlusion of the

bronchi or bronchioles by the exudate, the worms and their larvæ; and a compensatory vesicular emphysema may result. The infective larvæ, if swallowed in numbers, often cause digestive disturbances in penetrating the intestinal mucosa, and diarrhœa may result. Similarly, the fourth stage larvæ entering the lungs from the blood capillaries, may cause hæmorrhages and localised areas of inflammation. Neither of these lesions need be considered as serious when compared with the effects of the adults and unexpelled eggs and larvæ.

As examples of the second group, we may consider two common species to sheep. The first, *Protostrongylus rufescens*, however, is not so common as text-books suggest. The adults live in the smaller bronchioles and cause a capillary bronchitis and a lobular pneumonia. The lesions are very irregularly distributed, and are roughly conical in shape; the cones are much smaller than those sometimes seen in *Dictyocaulus* infections. There is an inflammation of the bronchioles with a catarrhal exudate containing shed epithelial cells and leucocytes. The exudate spreads to the alveoli, the walls of which become thickened by connective tissue and the capillaries congested or obliterated. The epithelium becomes transformed into cubical or columnar shapes and proliferates or is shed. The whole cone may become filled with a dense infiltration of small round cells and lose all resemblance to lung tissue. A fibrous pleurisy may develop at the base of the cone.

The other species, *Muellerius capillaris*, is, perhaps, the most common lung parasite of sheep. It usually lives in the alveoli or pulmonary parenchyma—especially in the subpleural connective tissues, where it forms nodules which may be as large as two centimetres in diameter. It is probable that the adults live for part of their life in the arteries and arterioles, as egg nodules are regularly scattered throughout the lung. The young egg is found surrounded by a mass of leucocytes limited peripherally by epithelioid cells. Outside of this is a thick zone of vesicular tissue consisting of alveoli solidly packed by round cells, and thickened alveolar septa. The nodule containing the adult is much larger and consists of a homogenous or granular material (which may calcify), probably resulting from the toxic degeneration of eosinophiles or small round cells. Giant cells may be present at the periphery, which is limited by a few layers of spindle-shaped connective tissue cells. Between the cells, the lung tissue is normal, except for a slight hypertrophy of the muscle fibres.

In the pulmonary vessels of cats we find a representative of the third group, *Ælurostrongylus abstrusus*; the adults appear to do no damage, but the eggs are scattered through the lungs, provoking a cellular reaction. Where they lodge in the finer branches of the artery they cause thrombi and a catarrhal reaction in the adjacent alveoli and those served by the vessel which they occlude. The catarrhal exudate is quickly eliminated and the thrombus resolved, so that by the time the egg has developed a larva, no pathological changes remain, beyond a slight thickening of the wall of the arteriole. Toxic changes are absent as the adult does not invade the lung tissue. If the infection is a heavy one, the number of eggs deposited in the lungs, at one time, may be so great that a fatal pneumonia results. This result is really accidental from the point of view of the parasite, as it cuts short the life cycle.

The Worm Nodule

Although the alimentary tract and the lungs are the favourite sites of nematodes, these worms can be found in all parts of the body. While the lesions vary with both host and parasite, there is a fundamental similarity in the structure of the nodules which are produced by all worms, their larvæ, and even their eggs.

The essential lesion is a tubercle similar to that produced against bacteria, except that the leucocytes are mainly eosinophiles instead of neutrophiles. These cells are numerous and more compact, however, and tend to localise the parasite in their midst. Those next to the worm degenerate and probably antitoxic substances are released. As soon as the necrosis of the parasite is pronounced, organisation sets in and proceeds along the usual lines—epithelioid and giant cells appear and tend to limit the spread of the toxic substances, probably released by the death of the worm. Once this disappears resolution is rapid and finally only a caseated or calcified nucleus remains.

In the intestinal wall of equines, especially in the cæcum, are often found sub-mucous nodules which may reach the size of a nut. In the centre lies an immature adult strongyle, coiled on itself and surrounded by degenerate and living eosinophiles and organising fibrous tissue. The nodule communicates with the lumen of the intestine and through this the worms escape to the intestine. Similar, but smaller, nodules are formed by the cylicostomes —the smaller species forming nodules in the mucosa, the larger in the sub-mucosa.

The genus Œsophagostomum is a large one related to the cyclicostomes of the horse: it occurs in a wide variety of animals. In some it seems to be a relatively harmless intestinal parasite—in others it causes nodular disease of the intestine. The most important species economically is *O. columbianum*. It appears to act in two different ways:—

(1) By the production of local nodules on the intestinal walls during its larval stage.

(2) By the production of a specific intoxication during both its larval and adult stages.

As usual, the effect of the parasite is much more severe in lambs than in adult sheep. Three types of nodule may be observed in practice—the reddish, the greenish and the hard nodule. All have an opening into the lumen of the intestine, through which the larvæ enter the mucous membranes. These degenerate in the neighbourhood of the worm and produce the green nodule. The final stage is the hard, indurated or calcified nodule (which is seldom seen in lambs). Bacterial contamination is very common and the simple helminthic nodule becomes converted into a pyogenic abscess; and this septic infection often spreads, rendering the condition one of the most serious of those initially produced by helminths. It is of interest to note, in passing, that intussusception is a common sequel to this nodule formation. The larvæ may wander beyond the intestine and enter the liver and adjacent lymph glands: the resulting lesions in these cases are usually sterile.

Trichinosis is another serious disease of all flesh-eating mammals. The adults live buried in the mucous membrane and by their presence alone may cause gastro-intestinal irritation, the seriousness of which depends to a great extent on the numbers present. The larvæ are passed into the blood stream and they enter the voluntary muscles. The muscle fibres degenerate and the intermuscular connective tissue proliferates to form a capsule for the spiralled larva. The form of the capsule varies with the host from spherical to lemon-shape. Ultimately calcification sets in, but the parasite may live for years. Finally, however, the worms die and in turn are calcified. The disease is unimportant from the veterinary point of view, but it is transmissible to man—an unnatural host—in whom the results are very serious. There is a general reaction as well as a local cellular one and the most striking result of this is an eosinophilia which may amount to 80 per cent. It is interesting to recall that this most characteristic feature of all the helminthic infections was first discovered by Sir William Osler in connection with this particular parasite.

Conclusions

We may summarise our conclusions as to the action of helminths of animals in general terms, under parasite and host, as follows:—

ACTION OF THE PARASITE.

(*a*) *Traumatic*—as when the parasite actually feeds on the host tissue.

(*b*) *Toxic*—as when the products of disassimilation or secretion by the parasite are absorbed by the host. Under this heading also come the secretions of larvæ which penetrate the skin or gut wall.

(*c*) *Mechanical*—as when Ascaris obliterates bile ducts, emboli caused by worms obstruct vessels and cysts exert pressure on organs.

(*d*) *Irritative*—as when Trichinella produces a gastro-intestinal irritation which may cause death within a few days after infection.

(*e*) *Infective*—as when worms either carry organisms into the body with them or allow bacteria already present in the intestine, to enter the damaged mucosa. This is exemplified by the introduction of sporulating anærobes by Fasciola into the liver, and by numerous intestinal infections.

REACTIONS OF THE HOST.

(1) Cellular Reactions.

(*a*) *Inflammatory* — simple inflammation characterised by fibro-vascular new tissue, more or less rich in leucocytes, in the centre of which is the parasitic body. The size of the area of inflammation depends largely on the parasite present. Eosinophile cells are especially characteristic of these lesions and giant cells are common. Calcification usually eventually results and may precede the death of the parasite.

(*b*) *Metaplastic*—The normal tissue may be altered—*e.g.*, in Paragonimus where the normal cylindrical epithelium becomes stratified pavement epithelium.

(*c*) *Hyperplastic*—There may be considerable hypertrophy of tissue, well illustrated by the alteration in the epithelium of the bile duct in liver fluke disease. The new growth of tissue may even become malignant and metastacise as has been seen in Opisthorchis infections of the liver and in *Cysticercus fasciolaris* infection in mice.

(2) Humoral Reactions.

The parasites and their "toxins" act as antigens and produce a variety of antibodies—specific and non-specific—and various types of immunity are produced. Of these, premunisation appears to be the most important, *e.g.*, a small infection often protects against a new heavy infection with the same species of worm. Sensitisation is another common effect.

The recording of the litters of pigs is, in the view of the *Scottish Farmer*, equally important as the recording of the milk yield of dairy cows, and it can be done with as little trouble. The system was started in Sweden, and Principal Stewart of the Moulton Institute explained the methods to the Discussion Society this year.

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Racehorses are cheap in Warsaw. An animal recently adjudged to be worth £2,000 could not get a buyer at £45, and two other impoverished owners sold their racehorses for £5 10s. and £2 15s. respectively.

SOME MODERN ASPECTS OF ANTHELMINTIC TREATMENT*

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In the first place, I should like to express my appreciation of the compliment that your Secretary has paid me in asking me to read a paper at this meeting of your Association.

The science of Parasitology now covers so extensive a field that it offers an embarrassingly wide choice of subjects that are of primary interest to the veterinarian. In making my selection, I have endeavoured to pick out one, the importance of which I believe is now recognised by all who are concerned with human and veterinary medicine.

Although worms are the oldest known internal parasites of man and animals, the principles of anthelmintic treatment had developed very little from ancient times until barely 20 years ago: a state of things that may seem rather surprising, in view of the fact that means for the investigation of anthelmintic problems have been available throughout the ages, and that anthelmintic treatment lends itself to experimental proof far more readily than do the kindred problems of the bacterial and protozoal infections. The position of anthelmintic treatment, as it stood some 20 years ago, is tersely expressed in the paragraph which I quote from an article recently written by Dr. Maurice C. Hall: "In 1915 it was practically impossible to give an intelligent answer to a question in regard to anthelmintic medication in the field of veterinary medicine. Books and journals contained endless formulæ incorporating scores of drugs for the removal of worms from domestic animals, but there was no critical evidence on which to judge the value of these drugs. The most that was offered was clinical experience, and as clinicians are a mixed lot, comprising good observers and sound thinkers on the one hand, and poor observers and unsound thinkers on the other, the recommendations of innumerable John Does and Richard Does, unknown to the reader, could not be sorted to distinguish the good from the bad."

From the standpoint of treatment, all forms of parasitic worms that infest the alimentary tract were generally included in a common category, notwithstanding that they belong to such diverse kinds as those represented by the different orders —Trematoda, Cestoda and Nematoda. It was, therefore, assumed that a remedy that was effective for the treatment of one kind of worm infestation might be used, with a reasonable prospect of success, in the treatment of other infestations of a widely different kind.

* An address delivered before the Eastern Counties Division, N.V.M.A. (Annual General Meeting, Norwich, February 22nd, 1933).

EXPERIMENTAL ANTHELMINTIC TREATMENT

Even so recently as the year 1918, common earthworms have been utilised as test organisms for experimental investigations *in vitro*, and chemical agents and drugs found to be non-toxic to the worms were rejected as possessing no anthelmintic value, while those which proved to be toxic were accepted as having anthelmintic possibilities. It is now known that little or no reliance can be placed on the results of such experiments. Information of value may be obtained by experiments *in vitro*, provided that the subject chosen for the test is of a suitable type, and that the physiological conditions of the experiment are adjusted to approximate as closely as possible to those which obtain in the normal environment of the parasite, but the results of experiments *in vitro* are merely preliminary and must be followed by trials *in vivo*, with the normal host when possible, alternatively with a closely related experimental subject.

Formerly, the value of an anthelmintic treatment was assessed by clinical observation alone. If the health of the patient improved after treatment, the anthelmintic was adjudged as being successful. When any examinations were made for the presence of worms or their eggs in the fæces passed after treatment, the methods of examination were generally inadequate and often led to erroneous conclusions.

Nowadays, the critical testing of an anthelmintic involves a considerable amount of laboratory work. A measured dose of the anthelmintic is given to the subject and a careful examination of all the fæces passed during a suitable period after treatment, is made. All the worms collected from the fæces are identified and counted. The subject is then killed and the entire contents of the stomach and intestines are submitted to a similar examination. From the two sets of figures so obtained, the percentage efficiency of the anthelmintic under trial may be computed. The accuracy of this method may be adversely affected by the fact that worms that have been killed in the stomach may be digested and those in the intestines may become so macerated as to be unrecognisable.

Alternatively, egg counts from samples of fæces passed before, and, at selected intervals, after treatment, afford evidence of the highest value, provided that the limitations of the method are recognised. Egg counts take no cognisance of larval, immature or male worms, nor of temporarily sterile females. Moreover, the action of the drug may inhibit egg laying and so bring about a temporary cessation in the appearance of eggs in the fæces. It is also an unfortunate fact that it is often impossible to distinguish the species to which the eggs belong, particularly those of many of the nematode worms that infest the alimentary canal of ruminants. Nevertheless, the egg-counting method has advantages, in that

it can be applied to the post-treatment examination of a larger number of subjects than is practicable in a method that involves the killing and *post-mortem* examination of the host animal.

Other factors which call for consideration in experimental treatment are the toxicity of the anthelmintic to the patient under various conditions, the response of individual patients, the period of fasting prior to treatment, the necessity of post-treatment purgation, and, in veterinary practice particularly, the ease of administration and the cost of the treatment.

THE SELECTION OF A SUITABLE ANTHELMINTIC

The ideal anthelmintic should possess the following attributes:—

While effective in expelling the particular variety of worm for which it is used, it should involve no risk of harm to the patient; it should, moreover, be easily and quickly administered, and not too costly. No anthelmintic has yet been, nor is likely to be, discovered, which complies with all of these requirements. It is necessary, therefore, to select that which possesses most of the desirable qualifications in the particular case.

No effective anthelmintic may be regarded as being quite innocuous to the host, and before undertaking the treatment of a case, the practitioner should give his careful consideration to possible contra-indications. The age, sex and condition of the patient are important matters. Very young, and also aged, animals are risky subjects for anthelmintic treatment. In the females, pregnancy is generally a contra-indication, for the reason that many anthelmintics of recognised efficiency, *e.g.*, male fern preparations, oil of chenopodium, thymol and beta-naphthol are liable to bring about abortion. The greatest caution should be exercised in the treatment of extremely debilitated, emaciated or starved subjects and these should undergo a preliminary treatment to improve their condition. Febrile and toxæmic conditions, gastro-enteritis, gastric stasis, and constipation are all adverse conditions that should, if possible, be remedied before the anthelmintic treatment is undertaken. Animals suffering from hepatic diseases, such as cirrhosis of the liver, fatty degeneration, or jaundice, are particularly susceptible to the injurious effects of the carbon-chlorine anthelmintics, such as carbon tetrachloride, on account of the acute central necrosis of the liver lobules that is invariably induced in a greater or less degree by these drugs. The existence of renal disease may be taken generally as a contra-indication to the administration of anthelmintics. The diet of the patient in treatments where a preliminary fast is not called for, *e.g.*, carbon tetrachloride, is a matter of some concern. On no account should carbon tetrachloride be administered with any readily absorbed oil, nor should the animal be allowed to feed on an oil- or fat-containing diet, *e.g.*, linseed- or cottonseed-cakes or even oats, maize or any oil-containing cereal, for at least 24 hours before and after the administration of the dose. An accident that is occasionally observed in the treatment of severe ascarid infections is that after a full dose of the selected anthelmintic, a mass of dead or paralysed worms is liable to occlude the atonic intestine of the weakened host and cause a fatal obstruction.

PURGATION WITH OR AFTER ANTHELMINTIC TREATMENT

Many anthelmintics, when administered in doses compatible with safety to the patient, cannot be relied upon to kill all the worms, many of the latter being merely stupefied or paralysed. If these worms are not quickly swept through the intestine and passed out of the body they may recover and re-attach themselves. It has often been suggested that one of the principal objects of this purgation is to remove the more or less toxic anthelmintic from the intestine before it has time to be absorbed. As a matter of fact, the anthelmintic is absorbed to a greater or less degree in the intestine whether a purgative is given or not, and the explanation offered by Hall is probably correct, *viz.*, that the administration of a purgative with, or immediately after, the anthelmintic, distributes the anthelmintic along the digestive tract and thus prevents localised absorption and local injury, or at least slows absorption, and thus reduces the shock to the patient.

It is customary, therefore, to combine the purgative with the anthelmintic whenever possible, but the choice of a suitable purgative calls for discretion.

Castor oil may be used with advantage in combination with oil of chenopodium, but inhibits the action of carbon tetrachloride to such an extent as to render it quite unsuitable for use with this anthelmintic. Magnesium sulphate is therefore preferred where purgation after the use of carbon tetrachloride is desired. When santonin is used, calomel is the most convenient purgative.

In veterinary practice, the administration of a purgative to empty the intestine before anthelmintic treatment is not generally desirable. It is necessary, however, if the patient is constipated and it is also desirable to administer a purgative before treating a case of tapeworm infection, to expose the "heads" as much as possible to the action of the drug.

If no action of the bowels takes place within four hours of the administration of the anthelmintic, then steps should be taken to bring it about by the administration of a promptly-acting purgative such as magnesium sulphate. Obstinate cases may even call for a hypodermic injection of arecoline hydro-bromide.

XUM

FASTING BEFORE DOSING

It is generally necessary to fast an animal before dosing with an anthelmintic in order to ensure that the bulky contents of the stomach and intestine shall not dilute the anthelmintic drug to such an extent as to render it useless. Moreover, the presence of food masses within the intestine may afford protection to the parasite. Horses require a fast of 12 to 24 hours before treatment for parasites in the stomach and small intestine, and 36 hours where the treatment is intended to rid the patient of *Strongyle* parasites in the large intestine. Pigs should be fasted for at least 24 hours. It is a practical impossibility to empty the first stomach of ruminant animals by fasting and, as a rule, an overnight fast is the most that can be allowed where these animals are concerned. Dogs and cats should be fasted overnight and the anthelmintic given in the early morning, and it is advisable to keep these animals on a light milk diet the day previous to dosing. After treatment, food should not be allowed until time has allowed the drug to get clear of the stomach. Three to four hours may be taken as an average period.

Failure or difficulty in removing worms from the alimentary canal of the host may be explained in various ways. As a rule, the larger the worm the more easily it can be removed; an exception to this rule is the tapeworm, the head of which is often deeply embedded in the mucous membrane of the intestine and is thereby protected from contact with the anthelmintic. A probable reason why the smaller nematodes which infest the intestine are often difficult, or even impossible, to remove, is the fact that they lie deeply embedded and protected in the layer of mucus with which the lining membrane of the bowel may be coated, or even buried in the mucous membrane itself. This protection may be held to account for the resistance to anthelmintic treatment exhibited by such worms as the lesser stomach worms of ruminants (*Ostertagia*) and *Trichostrongylus*. Whipworms (*Trichuris*), are difficult to remove, partly on account of their situation in the lower bowel and partly owing to the fact that they literally sew their heads and slender necks into the mucous membrane. The larvæ of some species of nematode worms encyst themselves in the wall of the bowel (the nodular worms, *Œsophagostomum columbianum* in the sheep, and *Œ. radiatum* in the ox), and are thus immune to the effects of drugs administered by the mouth. The same applies to the larvæ of the strongyles infesting the large intestine of equines.

Principal Drugs used in Modern Anthelmintic Treatment

Male Fern.—The powdered rhizome of the male fern (*Dryopteris filix-mas*) has been known as a drug from ancient times. Pliny and Galen were aware of its anthelmintic properties. Much confusion exists as to the chemical nature of the many different substances that have been isolated from the root, but it may be taken that the principal active agent is *filicic acid* or *filicin*, of which the rhizome contains about 3·5 per cent. The official preparation of the British Pharmacopœia is the Liquid Extract, which is prepared by percolating the powdered rhizome with ether and evaporating down to a thick oily liquid of a dark green colour containing not less than 20 per cent. of filicin. The official preparation of the United States Pharmacopœia is also prepared by ether percolation but is evaporated until a solid mass is obtained, known as *Oleoresina aspidii*. It is claimed that the oleoresin is more stable and retains its anthelmintic qualities better than the liquid extract.

A proprietary male fern preparation—Distol or Danistol—has come into prominence in recent years and has been extensively used for the treatment of liver fluke infections in sheep and cattle. Male fern preparations are strongly irritating and liable to cause severe gastro-enteritis. Moreover, on account of their tendency to induce abortion they should be administered with the greatest caution to pregnant animals. Male fern is the classic remedy for tapeworm infections, and is also of value for the treatment of fluke infections in bovines which are intolerant to carbon tetrachloride.

Areca Nut.—The areca nut or betel is obtained from the fruit of a palm (*Areca catechu*). The seeds are used extensively as a masticatory by the natives of most southern Asiatic countries and the Eastern Archipelago. Three alkaloids have been isolated from the seed, the important one of which, from the anthelmintic point of view, is *arecoline*, of which the seeds contain about 0·1 per cent. Arecoline is a colourless oily liquid that forms crystalline salts with acids, and of these, the hydrobromide is the compound generally used. Arecoline is highly toxic and is so readily absorbed that the powdered nut is often preferred for use as a tænicide. The active principle is unstable in the powdered root, and for this reason areca nut should be used freshly ground. Arecoline hydrobromide is highly efficient for the removal of tapeworms in dogs, but care must be taken not to exceed the prescribed dosage according to the weight of the patient. Preliminary purgation is necessary only if the animal is constipated, but it is advisable to keep the dog on a light milk diet the day prior to dosing and to fast overnight. A dose of a quick-acting purgative should be administered in from half an hour to one hour after dosing.

Carbon Tetrachloride.—Carbon tetrachloride was first discovered in 1849; it is a substance closely related to chloroform and was tried by Simpson as a general anæsthetic, but was abandoned on account of its disadvantages as com-

pared with chloroform. The drug was reintroduced into medicine by Hall in 1921 when he discovered that carbon tetrachloride would remove practically 100 per cent. of hookworms in dogs, and recommended its trial for the treatment of hookworm infestations in man. Carbon tetrachloride finds wide applications in manufacturing processes as a solvent, but the relatively crude qualities used for such purposes contain impurities which render the commercial product unsuitable for medicinal use, and specially purified or *medicinal* carbon tetrachloride should always be selected for anthelmintic treatment. The drug is rapidly absorbed in the intestine and it would appear that a large proportion of the dose is carried to the liver by the portal circulation. In the early days of the use of the drug, it was discovered that, even with the smallest doses, central necrosis of the cells of the liver lobules occurred. Observations have been made in which the liver parenchyma amounting to seven-tenths of the lobular substance has been destroyed without causing the death of the animal. Carbon tetrachloride may be administered in enormous doses without harmful effect. I myself have seen a sheep take a dose of 50 cubic centimetres without exhibiting toxic symptoms. On the other hand, small doses amounting to not more than 1 cubic centimetre sometimes have a fatal effect. In many of these cases the animals have been receiving a fat- or oil-containing diet. Minot and Cutler have shown that carbon tetrachloride can be given in enormous doses without danger to animals in which the blood-calcium ratio is high. It would appear that carbon tetrachloride is a highly dangerous drug if there is a blood calcium deficiency in the animal, *e.g.*, during lactation. If there is reason to suspect a calcium deficiency, this deficiency should be made good by suitable feeding. When toxic symptoms appear after treatment with the drug, intravenous injection of calcium chloride or calcium lactate is the best remedy. On the other hand, calcium deficiency is not the invariable cause of susceptibility to the toxic effects of carbon tetrachloride.

Carbon tetrachloride is a highly effective anthelmintic for the treatment of hookworm infections in dogs (*Ankylostoma* and *Uncinaria*), in sheep (*Bunostomum, Chabertia*), and for the common liver fluke (*Fasciola hepatica*) in ovines. It is also effective in a greater or less degree against most stomach and intestinal nematodes excepting *Ostertagia, Trichostrongylus* and *Nematodirus*. Half-grown and adult cattle are very intolerant to the drug and carbon tetrachloride should never be used in the treatment of these animals. Hall and Shillinger have reported favourably on the use of carbon tetrachloride for the treatment of worm infestations in cats, but Chopra and Chandler, after carrying out a large series of experiments, found the drug to be so highly toxic that they do not recommend its use for these animals. Poultry show a high degree of tolerance and the drug gives satisfactory results in the treatment of *Ascaridia* and *Heterakis* infections. Carbon tetrachloride is fairly effective for the removal of ascarids but is useless against tapeworms, and only slightly effective against whipworms (*Trichuris*). The fact that it has no tendency to cause abortion renders its use for the treatment of in-lamb ewes for fluke infection perfectly safe in this respect.

Tetrachlorethylene.—Tetrachlorethylene is a carbon chlorine compound, related to chloroform and carbon tetrachloride, which was introduced by the American helminthologists after carbon tetrachloride had been in use for a short time. It is claimed to be equally efficient and less toxic than carbon tetrachloride, but other workers are of the opinion that the drug has no advantage over carbon tetrachloride. It is useless for the treatment of fluke infection; otherwise, the drug serves the same purposes.

Oil of Chenopodium.—Oil of chenopodium is an essential oil derived for the most part from American worm seed (*Chenopodium anthelminticum*). It grows abundantly as a weed in many parts of the United States where it was introduced from South America. The plant was used as an anthelmintic by South American Indians in the days of Columbus, and infusions made from the seeds and leaves have been used in South America as a household remedy against intestinal parasites for many years. The drug was introduced into Europe by Baumler and Fribourg in 1881 for the treatment of hookworm disease in man, but with discouraging results. At the present time it has largely displaced santonin as a treatment for ascarid infections. The principal active principle is a heavy, clear yellow liquid that can be separated from the oil by fractional distillation at reduced pressure. It is known as *ascaridol* and the oil contains from 45 to 70 per cent. of this active principle. On account of this variation the ascaridol content of a sample of oil of chenopodium should be known in order that an accurate dose may be prescribed. Excessive doses set up a severe irritation of the whole of the gastro-intestinal tract. The oil is absorbed to some extent in the intestine and may be the cause of nervous symptoms —vertigo, deafness and drowsiness. Starved and poorly-nourished animals are far more susceptible to the harmful effects of the drug than are those in good condition, and for this reason the need for a diet rich in carbohydrate is indicated before treatment; likewise, excessive fasting should be avoided.

As stated above, oil of chenopodium ranks with santonin as a remedy for ascaris infections and has the advantage of being very much less costly. It is also effective on many of the intes-

tinal nematodes but has little or no effect on tapeworms. On account of the fact that it tends to cause constipation and to paralyse, but not to kill, the parasites, it should always be given with a purgative, generally castor oil.

Oil of chenopodium can often be used with advantage in combination with carbon tetrachloride. Many authorities are of the opinion that the mixture is more effective than either ingredient alone. Although each drug acts independently of the other, their action is supplementary and consequently smaller doses of each drug are effective. Agreement has not yet been reached as to the relative proportions in which the two drugs should be mixed. Some workers use one part of chenopodium to 10 parts of carbon tetrachloride, while others prefer two parts of chenopodium to three parts of carbon tetrachloride. Soper has stated that the proportions of the two drugs should depend on the nature of the parasite for which treatment is being given. In canine practice oil of chenopodium in suitable doses is highly effective for the removal of roundworms (*Toxocara canis*) and a high percentage of hookworm, but has practically no effect on tapeworms. The drug has the advantage that it can be given to puppies at an age when it would be dangerous to use santonin or areca nut. Oil of chenopodium has been found to be highly effective against the nematodes that infest the large intestine of the horse (*Strongylus* spp., *Trichonema* = *Cylicostomum*). Hall and his collaborators recommend that horses should be fasted for 36 hours and then be given 16 to 18 cubic centimetres of oil of chenopodium with a quart of linseed oil, either in one or two doses, and followed by another quart of linseed oil one to two hours later. For the treatment of ascarid infections in pigs, oil of chenopodium is eminently suitable. Pigs should be fasted for 24 hours before treatment and the drug should not be administered mixed with the food, because its action is thereby greatly impaired. Ascaridia infections in poultry can be treated successfully with oil of chenopodium but the drug has little effect on other nematodes and the tapeworms of birds.

Santonin.—For many years santonin was the most widely-recognised remedy for *Ascaris* and *Enterobius* infections in man and animals. A costly drug before the Great War, its greatly enhanced price at the present time precludes its widespread use in veterinary practice. Before the War, Russia was practically the sole source of supply, and it was the cutting off of this source that led to the development of the use of oil of chenopodium in America as a substitute.

In Russia, santonin was isolated from the aromatic flower heads of a plant—*Artemisia cina.* Average samples of flower heads contain 1·3 per cent. of santonin, but the quantity exceptionally reaches an amount of nearly 4 per cent. Attempts have been made to find other sources of the drug and several species of Artemisia have been investigated; of these, an Indian form— *Artemisia maritima,* has given the greatest promise.

Freshly prepared santonin is a white crystalline substance which acquires a yellowish tinge on exposure to light. It is very sparingly soluble in cold water. Excessive doses have serious toxic effects with symptoms of abdominal pain, nausea, diarrhœa and respiratory and cardiac depression. The drug has an irritant effect upon the kidneys. Santonin is best not given on an empty stomach on account of the greater risk of rapid absorption after solution in the gastric juice of the empty stomach, and it is often desirable to give repeated small doses on successive days rather than a single large dose.

Purgatives of an oily nature are unsuitable for use with this drug and calomel is generally to be preferred. Santonin can be mixed dry with powdered calomel and administered as a powder or pill, or given as a draught in a little milk. The drug is very effective for the removal of roundworms in dogs but should not be administered to puppies under the age of eight weeks.

Thymol.—Thymol is a white crystalline phenolic substance which is separated from the essential oils derived from the common thyme (*Thymus vulgaris*) and some other Labiates, and also from the Umbelliferous plant—*Carum copticum.* It is also produced synthetically. The drug is very slightly soluble in water but readily soluble in alcohol, fats and oils. In solution it is rapidly absorbed in the intestine and for this reason it should never be administered in solution, nor should alcohol, oils or fats be given at the time of dosing. Thymol is generally administered in the solid form or in the form of an emulsion prepared by dissolving the drug in a little alcohol and then precipitating it by the addition of water. If, through excessive doses or faulty methods of administration, absorption of the drug occurs, toxic symptoms resembling those of phenol poisoning will be set up. Thymol has been most widely used in veterinary practice for the treatment of intestinal Strongylosis in horses. The animals should be fasted before treatment and the treatment followed by the administration of a non-oily carthartic.

Rectal injections of an emulsion of thymol have been recommended for the treatment of helminth infections of the lower bowel, but the cost of the drug would prohibit its widespread use for this purpose in veterinary practice.

Hexyl Resorcinol.—This drug has recently been introduced as an anthelmintic by Lamson and his collaborators in America. It is claimed for it, notwithstanding that the drug is absorbed to a considerable extent, that this absorption has no toxic effect, while the drug has a high anthel-

mintic effect on ascarids, hookworms and whipworms.

Hexyl resorcinol is a white crystalline substance derived from coal tar. Notwithstanding its low degree of solubility in water (1: 1700), Robbins found that about 30 per cent. of the quantity ingested was absorbed and excreted almost entirely in the urine in a conjugated form, the balance being passed in an unaltered form in the fæces. The most delicate tests failed to disclose the presence of the drug in the blood stream, nor did careful microscopical examinations of sections of the various organs show the slightest pathological lesion.

A disadvantage of hexyl resorcinol is its local irritant effect on the oral mucous membrane, a property which makes it difficult to find a suitable method of administration. Aqueous suspensions are too unpalatable, while solutions in vegetable oils are ineffective. The most satisfactory method is that of rolling the hexyl resorcinol crystals into a ball and coating them with sugar.

Hexyl resorcinol appears to differ from most anthelmintics in that it is effective on various widely different types of parasites. Most effective against ascarids, it also is a good anthelmintic for hookworms and has a definite action on tapeworms, whipworms and threadworms (*Enterobius*).

Up to the present no toxic manifestations have yet been reported from the medicinal use of hexyl resorcinol, notwithstanding that thousands of cases of intestinal parasitic infestations of man and domestic animals, and many thousands of cases in which it has been used as a urinary antiseptic, have been treated. Owing to the fact that hexyl resorcinol reacts with foodstuffs, it is necessary that fasting should precede treatment and no food should be given for a period of three to four hours after treatment.

Tartar Emetic.—Potassium antimonyl tartrate, or tartar emetic, has been used for many years and has given moderately successful results in the treatment of ascarid infections in horses and pigs. Its emetic action renders it unsuitable for use as an anthelmintic in the case of animals where emesis is readily induced. Herbivorous animals are far more tolerant of tartar emetic than are dogs, cats and pigs.

In modern treatment the use of tartar emetic has found wide application in the treatment of blood fluke infections (*Schistosomiasis*) in human beings. One or two per cent. aqueous solutions of tartar emetic are injected intravenously, the treatment being repeated every second or third day and increasing in amount from 0·05 grams up to 0·75 grams. *Bovine Schistosomiasis* occurs in countries so near as France but, to the best of my knowledge, the infection is completely unknown in Great Britain.

HELMINTH PARASITES IN PARTS OF THE BODY OTHER THAN THE ALIMENTARY CANAL

The position with regard to anthelmintic treatment of lungworm infections in animals (*Dictyocaulus viviparus* and *filaria, Synthetocaulus rufescens, Muellerius capillaris, Metastrongylus* in pigs, *Ælurostrongylus* in cats, etc., is not so satisfactory as is now the case with most of the intestinal parasitic infestations.

The various methods of treatment of lungworm infections by inhalations, intratracheal injections, and mechanical removal, give palliative results, but it is doubtful whether infestation is more than partially removed by any of these means, although clinical symptoms may disappear and the affected animals improve materially in condition. Internal medication with mixtures containing volatile drugs (chloroform, carbon tetrachloride) which are excreted in part in the lungs, will often bring about a manifest improvement in the condition of animals suffering from pulmonary worm infections, but like the above mentioned methods of treatment, are merely palliative. Where tapeworm cysts (hydatid cysts, cysticerci, and the like) are concerned, no medicinal treatment has yet been found that is effective, and surgical intervention must be resorted to in those cases where treatment is feasible.

In concluding this subject, one should refer to the attention that is now paid to prophylaxis in the treatment of worm infestations in man and domestic animals. In ascarid infections particularly, much may be done to stamp out the infections by the adoption of simple prophylactic measures. The dosing of the bitch or sow to rid her of her worm infestation before her progeny is born, is far more satisfactory than to allow the young animals to become infected with ova derived from an infested mother. At the same time, a thorough cleansing of the quarters that are to be occupied by the young animals will reduce the possibility of infection to a minimum. A veterinarian who is consulted in respect to a helminth infection, in addition to prescribing or undertaking the actual treatment of the cases, should instruct his client as to the probable origin of the infection and means of preventing its recurrence.

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Dr. Robinson concluded by saying: This is a very big and wide subject. It is impossible, in the time at my disposal, to do more than touch upon the main points, but I have tried to select those which seem to me to be of the greatest interest to the general practitioner. (Applause.)

The President: It has been most interesting and a very valuable paper. I think Dr. Robinson will be very pleased to hear from you any points you wish to raise.

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Discussion

Mr. Vincent Boyle said that the point that interested him at the moment was the worm infestation of pigs. The pigs were treated and one got large numbers of worms from an ordinary herd. Was there any successful purge to drive the parasite from the lungs? He was not looking for the cure for the lung stage, but any particular purge.

Mr. P. Welch stated that turpentine and carbon tetrachloride, as vermifuges, were very familiar to him. He had never tried it yet, but in cases of husk he understood that a solution of salt was recommended for intratracheal treatment.

Mr. V. Boyle sought information as to the practical side of the treatment of pigs with oil of chenopodium.

Mr. H. P. Standley, junr., asked the essayist his views on the use of copper sulphate in stomach trouble in sheep.

Mr. E. Brayley Reynolds thanked Dr. Robinson for coming and dealing with that interesting subject, and proceeded: "The treatment of parasites in animals is, I suppose, one of the most difficult things that we have to deal with. Personally, I am approaching the subject from the point of view of horse practice. I was interested in what Dr. Robinson said in regard to the making of egg counts, for I myself make some thousands. It has been impressed on me that one can only accept the egg count as affording some indication of the degree of infestation and one cannot take it too literally. One comes across some cases where the increase in the number of eggs found after treatment is very noticeable. It has always been a matter of interest to try and find what is the explanation of this. I was interested in one point that Dr. Robinson put forward that I perhaps had overlooked, and that was that it was possible that the drug, while not clearing out the parasite, had inhibited the females for a time from laying eggs. That possibly is the explanation when one takes an egg count after treating an animal and finds a great fall in the numbers, and three weeks later finds that the number of eggs has gone up enormously. In regard to the egg count, I would like to speak of my own experience in sending fæces to laboratories for examination. The reports one usually gets back usually do not afford much guidance. They report numbers of eggs up to, say, 5,000, and after that speak of the quantity as 'many thousands' or 'uncountable thousands.' When we do the count ourselves we do, as far as possible, make an exact count, and it is surprising the numbers you do get sometimes. One may at times estimate as many as 200,000 in one ounce of fæces, and it is quite common to get up to 50,000 or 60,000. If we could get more detail from the laboratories it would be of great help. With regard to variation in the number of eggs, I think that one explanation of the big increases in the numbers of eggs counted after anthelmintic treatment is that the irritant effect of the drug on the intestinal mucous membrane causes the immature encysted worms to migrate to the lumen of the bowel. These larvæ within a given time become adult and start laying eggs.

"I had a parturition case in a mare two years ago. She had not a bad time foaling, although she sweated a great deal. Eight or nine hours afterwards she was taken very ill and I was asked to see her. What often happens, in such cases, is that the animal shows symptoms which are not really colic, but pains caused by contraction of the womb. That, however, was not the case in this instance. The mare had a temperature between 106° and 107° and had started purging. She died within 24 hours. In making the *post-mortem* I found there was an acute enteritis. The mucous membrane of the large intestine was 'as black as your hat.' What was a very noticeable feature, on opening the intestine, was that one could see uncountable thousands of some very small larval worms. I thought it would be a matter of interest to collect some fæces from the rectum, but on doing this, the subsequent egg count was found to be very low. I thought perhaps that encysted larvæ had migrated into the lumen of the bowel as the result of the upsetting conditions of the mare at the time of foaling. I had another case of a colt that I was asked to castrate standing. I did it in the morning. The colt was in the best of health then, but at 11 o'clock the same night it died, after showing symptoms similar to those of the mare. The *post-mortem* showed the same condition; the parasites were quite uncountable. I wonder if the fact of treating an animal which had a large number of larvæ in the mucous membrane might cause a sudden shedding of them.

"Dr. Robinson mentioned the treatment of giving oil of chenopodium in a quart of oil, followed by a second quart of oil two hours later. It seems a big dose: to get a quart of oil down a thoroughbred is a big undertaking. To obviate giving this large quantity, we add a proportion of solution of aloes. Do you think that might be harmful combined with chenopodium? I am interested in the giving of turpentine in combination with oil of chenopodium. I do not think the giving of thymol is of any use. A thymol emulsion is often given by stud owners themselves. They are all pretty well agreed on the point as to how much better their animals do after it. Perhaps it is not only stud owners, who know practically nothing about drugs, but even veterinary surgeons use it themselves. They put their animals on a week's treatment of thymol and are satisfied that their animals do much better. In animals so treated the egg count remains the same, but it is also certain that animals do better after it. Some of these people who run their

studs pretty carefully, make a practice of giving to every mare that comes to their stud a course of thymol treatment, so that she will not contaminate their paddocks, but I do not think that has any effect on the worm infestation. The reason they do well, I think, is that the thymol, in occasionally repeated doses, gives them a better digestion and absorption of their food.

"Dr. Robinson mentioned that the giving of anthelmintics to animals that are pregnant is dangerous. I agree with that, but I do know that it is a very common practice in the studs at Newmarket to treat all their in-foal mares in autumn with chenopodium in oil, with no bad effects. What one must really concentrate on is prevention; free the dams from infestation."

Mr. H. P. Standley, senr., observed that they had all listened with a great amount of pleasure to the paper Dr. Robinson had given them: no one could go out of that room without having learnt something from it. Anthelmintic treatment was a study by itself. The egg count, he thought, was a matter for the laboratories; a busy practitioner had no time to do it. He was very interested in the various remedies to which reference had been made. Had Dr. Robinson any remedy for small worms in a sheep's stomach, those which one could not see? It was a matter which they were constantly up against in the country, and they got tremendous losses in that district through it. One could kill the big ones with the arsenic and copper solution, but there seemed to be no way of dealing with the smaller ones. The essential point was the fasting and not to give the animal medicines while it was suffering from any other complaint. Hundreds of dogs were killed every year through the indiscriminate use of worm medicines. He congratulated Dr. Robinson on his paper.

Mr. W. Loveless asked whether parasitic worms caused injury in other ways than by blood sucking and general irritant effect.

THE REPLY

Dr. Robinson, in reply, said: "I will deal first with ascaris infection in pigs. So far as I am aware, there is no successful method of control of the migrating larvæ. With regard to the method of use of oil of chenopodium for pigs, I cannot tell you much, but you can doubtless find what you want by reference to the literature on the subject. Oil of chenopodium is best given with a quantity of castor oil amounting to a purgative dose, and if purgation does not result within two hours, a second dose of castor oil should be given. Small pigs are not difficult to dose, but in the case of a large boar or sow, the usual methods of control must be resorted to. A strong, stout spoon may be used for the administration of the dose, or the pig's head may be held upwards and the medicine poured into the pig's mouth direct from the measuring glass. The pig can be compelled to swallow the dose by occluding the nostrils with the finger tips.

"Turpentine has been used from very early times and was found to be fairly satisfactory, but turpentine in effective doses closely approaches the danger line and, I believe, effective doses from the anthelmintic point of view may have a very injurious effect upon the kidneys. With the new drugs available to-day there is no need to use turpentine any more The anthelmintic effects of these drugs are far ahead of those of turpentine. Turpentine will, if it has not already done so, fall into disuse as the modern anthelmintics become more generally known.

"Salt has little or no anthelmintic value. It may have some effect on larval worms, but that is doubtful. With regard to the anthelmintic treatment of husk, I do not think intratracheal injection of salt solution would be of any value. Some of the high coefficient carbolic disinfectants give very good results. At our Experimental Station we used to have a lot of trouble with husk in a flock of Hampshire Down sheep. In recent years we have treated these cases with a 1 per cent. dilution of a carbolic high-coefficient disinfectant (Kerol), injecting 10 c.cs. of the dilution into the trachea, without any harm to the sheep, and we have obtained excellent results and a complete disappearance of clinical signs of infection. Yet I question whether a complete extermination of lung worm infection can be ensured by any of the known methods of treatment. It is possible that some drug will be discovered, that, after absorption in the stomach and intestine, or after subcutaneous or intravenous injection, will be excreted by the lungs and will be potent enough to destroy these parasites without doing harm to the host.

"Copper sulphate is efficient for *Hæmonchus* infections, but has little or no effect on the smaller stomach worms (*Ostertagia*), and no effect on intestinal worms. Copper sulphate used with mustard has been recommended and the combination is said to be more effective than copper sulphate alone. Sodium arsenite with copper sulphate is more effective than copper sulphate alone. I imagine the reason why these salts are not effective against the intestinal nematodes is because absorption takes place in the upper part of the bowel. Speaking of the use of copper sulphate for the treatment of sheep, it should be borne in mind that more trouble is caused by hookworm (*Bunostomum*) and other intestinal worm infections than by the larger stomach worm. Sulphate of copper is absolutely useless for hookworm. The present tendency is to use an anthelmintic that will destroy both stomach and intestinal worms. Carbon tetrachloride finds favour in this respect.

"I would like to say how interested I was in the statements of Mr. Brayley Reynolds regarding egg counts. I think it would be a very excellent thing if veterinary surgeons in general took a little trouble to acquire facility in doing this work. Do you use a flotation or sedimentation method of egg counting?"

Mr. Reynolds: "Flotation."

Dr. Robinson: "I am not enamoured of the flotation method for quantitative estimations of the number of eggs. Some weeks ago I was discussing things with one of the county agricultural advisers who had interested himself particularly in the subject of worm infestations in sheep. He was very keen about egg counts as an indication of the post-treatment condition of the sheep. In speaking about the number of eggs per gramme of fæces, he said if more than 200 eggs per gramme were found, he thought it was time the farmer did something with regard to dosing. This struck me as being a very low figure and made me suspect the method (flotation) as being the explanation. I have done work in egg counting for many years and my experience is that rarely does a sheep show any serious symptoms of infestation unless the egg count rises above 1,000 eggs per gramme of fæces. I have known as many as 60,000 eggs in a gramme of sheep's fæces. I have tried flotation methods and have come to the conclusion that the results are liable to be very erratic so far as quantitative counts are concerned, and I now rely entirely on the sedimentation method. Mr. Brayley Reynolds

observed that often after dosing horses, he found no diminution in the egg count. I have had no first-hand experience of the treatment of strongyle infestations in horses; my experience has been mostly concerned with laboratory animals, and mainly sheep. But it occurs to me that in treating strongylosis in horses you have a type of parasite that offers exceptional difficulty. I have always thought that the dosing with a quart of oil twice must be a matter of some difficulty.

"I think it is probable that the stimulating effect of turpentine or thymol may improve digestion and account for the apparent improvement in condition, but I suggest that animals may harbour a fair amount of parasitic infection without showing signs of it."

Mr. Reynolds: "My object in employing the flotation method for egg counts is not because I think it is better than any other method, but perhaps it accommodates itself more to a busy practitioner. I recognise that it is only a very rough way of estimating, but it does show the variation better than from the laboratory reports. With regard to the large amount of oil that Hall recommends, perhaps in his case he had not to consider the giving of this himself. I agree with Dr. Robinson's opinion that in actual practice it is difficult, if not impossible, to attain a 100 per cent. efficiency in veterinary anthelmintic treatment, but such a high standard is not necessary. Animals tolerate quite a large amount of worm infestation without serious harm. Prevention of infection in the first instance is the finest way of dealing with it."

Dr. Robinson: "In reply to the question raised by Mr. H. P. Standley, senr., no effective remedy against the smaller stomach worms has yet been discovered.

"Mr. Loveless referred to the harmful effects of parasitic worms due to causes other than blood sucking. Many intestinal worms excrete toxic substances which are absorbed by the host and are often the cause of generalised symptoms of ill health. Moreover, the mechanical injury which they cause may at times afford a means of entry for septic organisms from the bowel, with serious consequences."

HAWKER PONY OWNERS PRAISED

An interesting event in the north-eastern area, is the annual supper given to horse and pony owning hawkers of coal, fruit, fish, etc.,' in Newcastle and district, by the Newcastle Branch of the R.S.P.C.A.

At the third of these, held by courtesy of the *North Mail and Chronicle*, in "Chronicle Hall," Mr. J. Carr (Deputy Chief Constable) said: "It is seldom that any of you are proceeded against for neglect or ill-usage of your ponies now, which is very creditable."

Giving the 200 hawkers present advice on the care and management of their horses, Mr. H. S. Elphick, Hon. Veterinary Surgeon to the branch, said: "Six prosecutions only in three years is an excellent gesture in response to my bit of teaching."

Colonel Pinkney presided (in the absence of Mr. Boanin, who is Chairman of the Council), and was supported by, among others, Mr. H. Thornton (Assistant Veterinary Inspector for the City), Mr. J. S. Watson, Mr. J. E. Dodds, Mr. Hubert Coulson, Captain Davis, and Captain L. H. Miller (Secretary).

The Veterinary Record

April 15th, 1933.

MEDICAL HELMINTHOLOGY

THE science of helminthology, one of the youngest of the medico-biological sciences, is rapidly growing up. A child of the parent subject "parasitology," it has become decreasingly dependent upon the allied subjects, bacteriology, entomology and protozoölogy, and is now able itself to provide a field of research large enough for the activities of numerous specialists.

The early followers of helminthology, as also of each of the other sciences which have just been mentioned, were for the most part biologists who occupied themselves in studying the diversity of form and the interesting and complex life-histories of the various specimens which they were able to collect from wild and domestic animals. In these foundation stages the medical aspect was quite undeveloped, and although pathologists were occasionally attracted by some problem of worm infection the whole-time specialised medical or veterinary helminthologist was unknown.

There is a certain æsthetic satisfaction to be derived from the study of morphology and the orderly arrangement of the numerous and varied forms to be found in any natural group of organisms, but a tendency may be observed for this very essential foundation work to outlive its usefulness. While research into the medical aspect of helminthology was still in its early stages, with no tradition to lend support, its advance was somewhat retarded as a result of the ultra-academic sentiment that 'polite learning and true culture admit no contact with utility." Many medical men whose training fitted them for work of more direct economic value devoted themselves to systematic studies when their energies might have been directed along lines of more obvious value to medicine, the available information on the taxonomy having become sufficient for the work on symptomatology, diagnosis, pathology, treatment and prevention to proceed most advantageously. That phase, however, was only temporary and has now been left behind, and the medical and veterinary side of helminthology is developing along the same sound lines as were followed in the first place in medical and veterinary bacteriology: the investigation of disease causation by

worms is the subject of concentrated study by students of human and veterinary medicine in all parts of the world and much of the systematic work which still remains to be done is left to biologists.

In the current issue of our journal we publish two papers on aspects of the subject in which we, as followers of medicine, are essentially interested. Dr. Cameron's paper on "The Comparative Pathology of Helminths" gives a useful summary of the general reactions of the host's tissues as well as of some of the specific reactions to certain parasitic worms, and assists us to estimate more accurately the importance of helminths and to unravel that complex relationship of host and parasite in health and in disease.

The second paper deals with that branch which links the subject with pharmacology. The scientific study of anthelmintics is of very recent origin; Hall's early work made rapid headway, but subsequent to his discovery of carbon tetrachloride and tetrachlorethylene no drug of outstanding value appears to have been found until 1930, when hexyl resorcinol was shown to have a marked action on ascarids and hookworms. The bactericidal action of this drug has been known since 1924, its peculiar merit being a very marked toxicity for bacteria (it is much more toxic than carbolic acid) together with an absence of toxicity for mammals; and its most notable properties as an anthelmintic are its toxicity for both nematodes and cestodes, an unusual combination, and its non-toxicity for the host.

Perhaps the possibility of finding a perfect anthelmintic is a little less remote than Dr. Robinson supposes; species susceptibility has been shown in some instances to be very marked; indeed, rotenone and pyrethrine I are extraordinarily toxic for insects but relatively harmless to warm-blooded animals, and it is not improbable that something may yet be found with an extraordinary specific affinity for some vital organ of helminth parasites.

For the present time, however, we must proceed carefully, paying much attention to prophylaxis, and in this connection the last sentence in Dr. Robinson's paper is very significant—in giving advice as to the prevention of helminthic disease the veterinarian may be performing a more important and more generally useful service than by the administration of anthelmintics, and the treatment of animals which are already affected.

Clinical Communications

TUBERCULOSIS IN A GREAT DANE

J. M. ARMFIELD, M.R.C.V.S.
Chipstead, Surrey

This dog was nine months old and the history was that for some time there had been wasting and weakness.

When I was called in the animal was too weak to stand—the pulse was 120 to the minute.

The dog was dosed for worms and put on digitalis, but after five days showed no improvement and was therefore destroyed.

The *post-mortem* revealed a large number of maw worms in the intestine, and three to four enlarged mesenteric glands about three-quarters of an inch in diameter, containing an almost white pus-like discharge. On microscopic examination large quantities of tubercle bacilli were seen after staining with Ziehl-Neelsen.

This case is reported because of the comparative rarity of tuberculosis in dogs.

Although extensive enquiries were made the source of the disease could not be ascertained.

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THE INDUCTION OF ŒSTRUS IN CATTLE BY THE USE OF PROLAN (BAYER)

J. F. D. TUTT, F.R.C.V.S.
Winchester

Early in January of this year, the Bayer Company very kindly placed at my disposal a supply of "Prolan" (standardised anterior pituitary hormone) to try on cattle not showing signs of œstrus.

The dose of this preparation (administered subcutaneously) is as follows:—

Mares and cows	125 units (rat units)
Sows	50 units („ „)
Bitches	5–10 units („ „)

The needle must not be sterilised with a disinfectant or alcohol, but by boiling, otherwise the "Prolan" may be destroyed or weakened. One injection usually suffices. In the absence of œstrus, the injection must not be repeated until 21 days have elapsed. If this second injection has no effect, there are, as a rule, no prospects of improvement. In the case of valuable animals, however, the effect of repeated injections should be tried.

INDICATIONS.

The Bayer Company state that the indications for the use of this preparation are:—

1. Sterility of hormonic etiology; ovarian hypofunction.

2. Hypofunction of the sexual organs, which may be connected with hypoplasia of the uterus and ovaries, or with corpus luteum persistens.

3. Sterility due to inflammatory changes in the uterus and annexa (endometritis, ovarian

cysts, etc.) is not directly influenced, but "Prolan" often has a favourable influence on the healing process by bringing about hyperæmia.

They further state that an injection of "Prolan" usually causes œstrus in four to ten days. However, it may be delayed until the next period, *i.e.*, up to 21 days, or it may first appear as a so-called "hidden" œstrus, in which case the usual symptoms of restlessness are missing. The animals take the bull, however, and usually become pregnant. If the "hidden" or "passive" œstrus is allowed to pass unused, the next is usually noticeable. The ovaries are examined before and after treatment, and dealt with according to their condition. It is a good plan to give them a good squeezing, or so-called "massage."

The preparation is inexpensive, and is sent out in packages each containing two ampoules of 125 units of the "Prolan" in powder form, and two ampoules of 5 c.c. distilled water.

The injection is made up at the time it is required for use, by adding the distilled water to the "Prolan" powder, shaking until dissolved, and then injecting subcutaneously.

A number of cases have been treated with this preparation, and I append, without comment, eight cases in which the animal had shown no signs of œstrum since the previous parturition. Reports on other cases are not yet available, but will be recorded in due course.

Class of Animal.	Name.	Age.	Date examined.	Previous History.	Clinical Findings.	Treatment.	Oestrus.
1. Shorthorn Cow, non-pedigree	Baby	4	27/1/33	Aborted, Oct. 31, 1932. Inoculated with living abortus vaccine, Nov. 27, 1932 No œstrus noticed.	Slight Endometritis.	"Prolan," 125 units. Ovarian massage. Contramine, 2 c.c.	31/1/33
2. Shorthorn Cow, non-pedigree	Floss	8	7/2/33	Calved normally and to full term on Sept. 9, 1932. Not in œstrus since.	Os patent, with sanious mucous discharge. Right cornu slightly enlarged.	"Prolan," 125 units. Lugol (1%) 25 c.c. into right cornu. Ovaries massaged.	23/2 33
3. Guernsey Cow, cross-bred	Molly	8	7/2/33	Calved, Nov. 10, 1932, 11 days before time. Had placental retention and persisting discharge. No. œstrus.	Endometritis. Corpus leuteum left ovary.	"Prolan" 125 units. Lugol (1%) 250 c.c. into uterus. Corpus luteum expressed. Ovaries massaged.	15/2/33
4. Shorthorn Cow	Puffin	5	7/2/33	Calved to full term, Nov. 28, 1932. Not in œstrus since.	Nothing abnormal. Functional.	"Prolan," 125 units. Ovaries massaged.	6/3/33
5. Shorthorn Cow	Peerless	7	7/2/33	Calved to full term. Normal. Not in œstrus since.	Uterus not completely involuted. Otherwise normal. Functional.	"Prolan," 125 units. Ovaries massaged. Lugol (1%) 25 c.c. to stimulate uterus.	14/2/33
6. Shorthorn Cow	Beauty	5	7/2/33	Aborted, Dec. 3, 1932, 6 weeks before full term. Not in œstrus since.	Cervicitis. Slight Endometritis.	25 c.c. Lugol (1%) and Cervix dressed. "Prolan," 125 units. Ovaries massaged.	27/2/33
7. Shorthorn Cow	Shamrock	6	7/2/33	Calved, Jan. 1, 1933. Normal. Not in œstrus since.	Nothing abnormal.	"Prolan," 125 units. Ovaries massaged.	11/2/33 Turned to service on 2/3/33.
8. Shorthorn Cow	Snowdrop	9	7/2/33	Had dead calf to full term, June 15, 1932. Came into season regularly, but turned three times, since when has not shown signs of œstrus. Discharge noticed since third return to service.	Endometritis. Salpingitis (mild) cystic right ovary.	Lugol (1%) 300 c.c. "Prolan," 125 units. Cysts ruptured. Ovaries massaged.	15/2/33

Abstracts

[**Sprains of the Fetlock and Pastern Joints.** Dr. Scheike. *Zeitschrift für Veterinärkunde.* No. 10. October, 1930. pp. 362-368.]

Most authorities find that the fetlock joint is sprained about twice as often as the pastern joint.

The fetlock joint is supported by the sesamoid bones and their attachments and is a nearly perfect hinge, permitting only flexion and extension while the animal is standing. Slight lateral movements are possible during flexion.

The pastern joint is also a hinge, but permits a greater degree of rotation.

Distortion of the joints occurs through sudden movements in excess of the physiological limits of flexion, extension, etc.

Excessive flexion of the fetlock joint causes stretching of the extensors in the region of the capsular ligament, and forcible extension promotes dragging of the distal sesamoid ligaments. Extension of the pastern joint strains the volar and lateral ligaments of that joint.

Eberlein lays stress on the indirect or internal contusion which takes place in sprains of these joints, particularly in that of the fetlock.

In the field exact diagnosis does not always obtain, since bandaging and rest promote recovery in a variety of conditions.

The anatomical changes occurring as the result of sprains are manifold. They may be of the nature of inflammation, strain of the capsular or lateral ligaments of the joints, or of hæmorrhages into the last named.

Symptoms are those of pain, heat and swelling of the joint concerned, with supporting leg lameness and discomfort on manipulation. Frequently symptoms are not clear till the lapse of 12 to 24 hours. Repeated examinations generally point to the site of the injury, which may be established by the help of a diagnostic injection.

H. H.

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[**Colic and Sclerostome Infestation in the Mule.** Dr. Gackstatter. *Zeitschrift für Veterinärkunde.* No. 10. October, 1930. pp. 353-357.]

Mules have a higher resistance to internal diseases, especially colic, than horses, given the same conditions.

Post-mortem examinations on mules have only on one occasion shown ascarides and numerous sclerostomes in the mucous membrane. No collection of sclerostomes has been found under the serosa or in organs or aneurisms.

In the flotation examinations of the fæces of 120 mules sugar solution was found to be the most satisfactory medium, in the proportions of 27 c.c. water, 3 c.c. fæces and 30 c.c. sugar solution. The specimens were strained, mixed and examined after one hour. Eggs were found in every sample.

It was not possible to differentiate accurately between the eggs of different varieties, but after incubation, larvæ of *Scl. edentatum, vulgare* and *tetracanthum* were identified.

Of the animals at the station of Landsberg, in seven years, colic occurred in 9·42 per cent. of the horses and terminated fatally in ·46 per cent. of the total strength. In the mules during the same period colic occurred in 1·54 per cent. and deaths from it in ·17 per cent. of the total strength.

It must be concluded that mules are better protected than horses from affections and infestations of the digestive tract, owing to some constitutional quality.

H. H.

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[**Tumours of the Heart.** Dr. Mossdorf. *Zeitschrift für Veterinärkunde.* No. 11. November, 1930. pp. 409-413.]

Primary tumours of the heart occur in the domestic animals in the following frequency: ox, horse, dog, sheep, pig, fowl. The most usual age in horses and cattle is from 15 to 20 years, in the dog from five to 15. The commonest form is the fibroma; then comes the lymphosarcoma (especially in the ox); after that the myxoma and, lastly, the lipoma.

Benign tumours appear to occur generally in the cavities, usually on the right side. Malignant types invade the right auricle and resemble polypi. Metastatic malignant neoplasms, such as sarcomata and carcinomata, as a rule occupy the myocardium and may encroach on the cavities.

Clinically, tumours may give rise to a variety of symptoms, depending on their size, position and nature, and, alternatively may cause none, the condition being discovered at the autopsy. A frequent symptom in the dog is ascites.

In a case in a horse the author found that epistaxis was an outstanding symptom. *Post-mortem* examination disclosed a fibroma or myxo-fibroma in the left ventricle.

H. H.

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[**Studies on the Control of Johne's Disease.** Hagan, W. A., and Zeissig. A. *J.A.V.M.A.* N.S. 35. 3. Pp. 391-407. Tables 4. Refs. 8.]

In this contribution to the proceedings of the Annual Meeting of the United States Live Stock Sanitary Association, the authors commence with a warning that unless control officials arouse themselves and attack the problem of the control of Johne's disease soon, it will not be many years before the U.S.A. are faced with a situation, in respect of this disease, as serious as that which confronts European countries, from which it came. With funds made avail-

able by the State of New York, they have been studying this affection, with special reference to control measures, for several years, and the conclusion is reached that resort should be had to vaccination methods only when it becomes evident that successful diagnostic procedures, enabling the early detection and elimination of animals in the incubative period, are not available.

In this communication are recorded data accumulated as the result of observation of the behaviour of the disease in an experimental herd established six years ago, and to which periodic diagnostic tests have been applied, as also to a number of privately-owned, naturally infected herds.

Discussion is here limited to the use of avian tuberculin as the diagnostic material, and the methods of its preparation and application are described. Data are given to support the conclusion that Johne's disease in cattle can be diagnosed with a reasonable degree of accuracy by the aid of avian tuberculin injected intravenously: the dosage of tuberculin must be carefully graded so as to induce sharp reactions in affected cattle and give none in normal cattle.

In the experimental herd—in which infection was introduced by means of the addition of naturally-infected animals, and by the drenching of calves with infective material obtained from outside herds—successive tests upon all animals reflected an accurate picture of the progress of the disease, while in the privately-owned, naturally infected herds (18 in number), from which the reactors were removed and slaughtered, the disease had apparently been eliminated from several by two or three annual tests, though in others it appeared that little or no progress had been made. It is suggested that the persistence of infection on infected farms may be due to the unusual vitality of the Johne bacillus which, like the avian type tubercle bacillus, appears able to remain alive on unfavourable media for long periods of time.

Complement fixation tests were conducted as a routine measure on all animals in the experimental herd about once a month, the tests agreeing with the allergic tests in a large number of cases. Complement fixation test is therefore useful as a confirmation test, used with the allergic test, especially in those animals which have developed clinical signs of the disease and do not react to the allergic test—for these animals practically always react serologically.

W. B.

Anæmia occurring in suckling pigs between the third and fifth weeks of life, is a common occurrence in Prussia. Ferrous sulphate yielded good results both for prophylactic and for curative treatment.

THE NATIONAL VETERINARY BENEVOLENT AND MUTUAL DEFENCE SOCIETY

ANNUAL GENERAL MEETING*

The Annual General Meeting of the National Veterinary Benevolent and Mutual Defence Society was held at the Grand Hotel, Aytoun Street, Manchester, on Wednesday, March 15th, 1933.

The Chair was taken by the President, W. Woods, Esq., and other members present were Messrs. F. L. Gooch, J. H. Wright, E. H. Curbishley, T. Wilson, J. Spruell, J. H. White, G. H. Locke, A. W. Noel Pillers, J. Holroyd, G. Mayall, F. Hopkin (Hon. Treasurer) and R. C. Locke (Hon. Secretary).

Apologies for unavoidable absence were received from Messrs. J. Lindsay, Jackson Young, J. W. Procter and J. Clarkson.

The minutes of the previous Annual General Meeting were read and confirmed.

Arising from the minutes, Mr. Woods stated that Messrs. Litton, Pownall, Blakey and Higson had again been appointed as professional auditors, and he had much pleasure in announcing that they had offered to reduce their fee by three guineas.

Election of Officers 1933-34

President.—It was proposed by Mr. G. H. Locke and seconded by Mr. A. W. Noel Pillers, that Mr. W. Woods be re-elected President for the ensuing year. The proposal was carried unanimously.

Vice-President.—Major J. H. Wright proposed, Mr. J. Spruell seconded, and it was unanimously resolved, that Mr. J. Lindsay be re-elected Vice-President for the ensuing year.

Council.—The following were elected as Council of the Society for the ensuing year: Mr. A. W. Noel Pillers, Sir Frederick Hobday, Messrs. J. Holroyd, E. H. Curbishley, J. H. Wright, J. Spruell, D. Imrie, J. Clarkson, F. L. Gooch, W. D. Rees, W. Shipley, W. K. Townson, L. W. Wynn Lloyd, A. Cornish-Bowden, G. H. Locke, S. Sumner, senr., W. Packman and J. W. Brittlebank.

Hon. Treasurer.—Mr. F. Hopkin was proposed by Mr. W. Woods and seconded by Mr. E. H. Curbishley for this office for the ensuing year. The proposition was carried unanimously.

Hon. Secretary.—On the proposition of Major F. L. Gooch, seconded by Mr. J. Holroyd, it was unanimously resolved that Mr. R. C. Locke be re-elected as Hon. Secretary.

Auditors.—Mr. J. Spruell proposed, Mr. R. C. Locke seconded, and it was unanimously agreed, that Major J. Adamson be re-elected Honorary Auditor for the ensuing year. Messrs. Litton,

* Received for publication March 21st.

Pownall, Blakey and Higson were re-appointed as professional auditors, on the proposition of Mr. G. H. Locke, seconded by Mr. J. Spruell.

Address by the President

Following his re-election as President, Mr. Woods said:—

"Years ago it was the usual custom for the President to address a few remarks at the Annual Meeting, with a view to spreading the knowledge of the existence of a Society which, for a negligible subscription, would undertake to advise and to assist in the defence of any of its members who were unjustly attacked and, at the same time, so far as its funds would permit, to assist by pecuniary grants any of its members or relatives of members who had fallen on bad times.

"For many years there were no claims from members, which seemed to prove that those who were provident enough to join the Society were those who were not improvident in business and other affairs of life. Our funds gradually increased owing to the astonishingly small demands from its members, until it was felt that, while retaining our power to satisfy the claims of our own members, we had a sufficient balance to help deserving cases of benevolence outside our membership. This Society was not, at its inception, intended to help any outside its own members, and I wish to emphasise that if its own members were in need to the extent of its surplus funds, there would be no help whatever for non-members.

"You will naturally exclaim: 'What a rush of veterinary surgeons you must have to become members!' Well, you would naturally expect this to be the case, but, as a matter of fact, only about 10 per cent. of the profession are willing to pay ten shillings and sixpence a year for the protection afforded by the Society, which is the only protection Society within the profession.

"Now as to the limits of the Society—it is quite true it has not been helped by being most ungenerously dubbed 'a Manchester Society.' It is quite true that the Society was founded by a number of gentlemen within easy distance of Manchester. It is quite true, also, that its headquarters are in Manchester, and its Executive must necessarily be near Manchester—we have emergency meetings, sometimes a couple in a week. But the Society could not possibly be more national either in character or scope. Its Council is drawn from all parts of the kingdom and we make use of it in different parts of the country to investigate cases for our guidance and action, and I would like to state publicly that never, upon request, has any member failed to exert himself—sometimes to a considerable extent—and never once has any member asked for even his out-of-pocket expenses for the time and trouble he has taken on our behalf. Of course, we pay for professional evidence in Court cases, though I may say here, not an official of the Society has ever included in it his out-of-pocket expenses which, sometimes, are not inconsiderable, for whatever he may have done; and I here gratefully acknowledge the moderate emolument that even the highest in our profession are willing to accept when acting on our behalf.

"There are just two other things to which I wish to draw your attention. The first is that I think it worthy of consideration as to whether the present scope of our preamble should be widened so as to permit our funds to be used in other ways for the benefit of the members. The second is that I would ask all members of the Society to read the Rules. They are simple, easy to understand, and consequently rarely obeyed, and we frequently find members in a tangle before they apply to us at all. Please excuse the length of these remarks."

HON. TREASURER'S REPORT

The Hon. Treasurer, Mr. F. Hopkin, in submitting his Report and Balance-sheet for the year ending December 31st, 1932, referred to the present satisfactory state of the finances of the Society, but pointed out that a reduction of income on investments would be experienced during the coming year on account of the lower rates of interest available. A pleasing feature was that the membership had again shown an increase, although the representation was still far below the figure that one would expect.

It was proposed by Major F. L. Gooch, seconded by Mr. G. Mayall, and unanimously resolved, that the Report and Balance-sheet for 1932 be approved and adopted.

A vote of thanks to the retiring officials was proposed by Mr. J. H. White, seconded by Mr. T. Wilson, and carried unanimously.

There being no further business, the meeting was closed.

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Beneficiaries

Name.	*Age.*	*Relation to M.R.C.V.S.*	*Grant.*
M. J. ...	80 ...	Widow ...	£2 per month
K. L. H. ...	80 ...	„ ...	£2 „ „
M. L. M. ...	32 ...	„ ...	£4 „ „
M. D. ...	60 ...	„ ...	£3 „ „
E. B. C. ...	50 ...	„ ...	£2 „ „
M. A. ...	38 ...	„ ...	£2 „ „
M. B. B. ...	67 ...	Daughter ...	£2 „ „
K. E. C. ...	70 ...	Widow ...	£2 „ „
H. T. ...	69 ...	„ ...	£2 „ „
S. Y. ...	75 ...	„ ...	£2 „ „ (later increased to £3 per month)
M. R. ...	75 ...	„ ...	£3 per month
E. M.	67 ...	„ ...	£2 „ „
A. J. P. ...	61 ...	„ ...	£2 „ „
E. W. ...	71 ...	„ ...	£2 „ „

Defence Cases

Case.	*Particulars.*	*Action taken.*	
1	Threatened action for alleged negligence of locum tenens in surgical operation.	Dispute settled out of court.	Society paid costs incurred by member.
2	Threatened action for alleged negligence in treatment of cow.	Dispute settled out of court.	Society paid half the costs.
3	Threatened claim for damages following operation on greyhound.	Advice given.	Claim not proceeded with.
4	Claim for alleged negligence in treatment of cow.	Society defended.	Judgment given in favour of M.R.C.V.S.
5	Threatened action for alleged negligence in treatment of bitch.	Advice given.	Claim not proceeded. with.
6	Claim against member following treatment of cow by locum tenens.	Advice given.	Dispute settled out of court.

N.V.M.A. Divisional Report

EASTERN COUNTIES V.M.A.*

ANNUAL GENERAL MEETING AT NORWICH

The fifty-seventh Annual General Meeting of the Eastern Counties Veterinary Medical Association was held at the Maid's Head Hotel, Norwich, on Wednesday, February 22nd, with the President, Mr. G. T. Matthews, M.R.C.V.S., in the chair. Other members present were: Messrs. E. Brayley Reynolds, C. C. Nesling, W. Loveless, P. Welch, H. P. Standley, senr., Harry Low, Vincent Boyle, and H. P. Standley, junr., Hon. Secretary. Dr. L. E. Robinson, of the Cooper Technical Bureau, London, and Mr. T. W. Farmer were present as visitors.

Paper.—As the essayist had to return to London, the first business dealt with was the reading by Dr. L. E. Robinson, PH.D. (CANTAB.), A.R.C.S. (LOND.), of the Cooper Technical Bureau, London, of a paper on "Some Modern Aspects of Anthelmintic Treatment." [Dr. Robinson's paper, and a report of the ensuing discussion and of the essayist's reply, are published elsewhere in this issue.—ED., *V.R.*]

The PRESIDENT expressed the hearty thanks of the gathering to Dr. Robinson for his very interesting and instructive talk, and Dr. Robinson responded.

* Received for publication March 11th.

The minutes of the last meeting, as published in the *Veterinary Record*, were taken as read, and signed.

Apologies for absence were received from: Professor Buxton, Major F. Gooch, Sir Frederick Hobday, Captain Townsend, Captain W. Wortley, Colonel Castle, Major J. T. Heatley, Captain W. Waters, Messrs. H. Loveless, A. J. Beeson, W. Turtill, M. Bray, J. Cochrane Dyet, J. Reid, F. Thurston, J. M. Currie and B. H. Claxton.

Correspondence.—(1) From Mr. R. F. Bain, tendering his resignation from the Society, as he had moved from the district. It was decided to accept Mr. Bain's resignation with regret.

(2) From the N.V.M.A. asking the Society to appoint an honorary Divisional Representative of the *Veterinary Record*. Mr. E. Brayley Reynolds was unanimously appointed to this office.

(3) From the National Horse Association of Great Britain. It was decided that the Division become affiliated to this body.

Obituary.—The PRESIDENT referred to the loss the Division had sustained by the death of Mr. Godbold, senr., of Stowmarket. Those present stood in silence in respect to his memory and agreed to send a letter of sympathy to the family.

Balance Sheet.—The financial state of the Society was shown to be fairly satisfactory. It was agreed to send the usual donation of £5 to the Royal Agricultural Benevolent Institution.

Election of Office Bearers for 1933

The following were elected:—

President.—Captain W. Waters.

Vice-Presidents.—Messrs. G. T. Matthews, H. P. Standley, senr., and Professor J. B. Buxton.

Committee.—Messrs. V. Boyle, W. H. Wortley, P. R. Turner, W. Shipley, W. H. Dennett, W. J. Browning, E. B. Reynolds, T. G. Heatley and W. A. Wood.

It was decided that the Committee should meet half-an-hour before each of the General Meetings.

Auditors.—Messrs. T. E. Barcham and H. Buckingham.

Secretary.—Mr. H. P. Standley, junr.

Representatives to Council, N.V.M.A.—Messrs. G. T. Matthews and H. P. Standley, senr.

Next Meeting.—It was decided to hold the Summer Meeting at Great Yarmouth.

Exhibit.—Mr. E. BRAYLEY REYNOLDS exhibited a *post-mortem* specimen of a thoroughbred foal with fracture of the fourth, fifth and sixth ribs, and bruising of the cardiac muscle, which caused the foal's death at birth.

The meeting concluded with a very hearty vote of thanks to Mr. G. T. Matthews for the admirable way he had fulfilled the duties of President during his year of office.

H. P. STANDLEY, Junr., *Hon. Secretary.*

Notes and News

The Editor will be glad to receive items of professional interest for inclusion in these columns.

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DIARY OF EVENTS

April 24th.—Meeting of the Editorial Committee, N.V.M.A., at 2, Verulam Buildings, Gray's Inn, W.C.1, at 4.30 p.m.

April 25th.—Meeting of the Derbyshire Division, N.V.M.A., at Derby.

April 28th.—Meeting of the Yorkshire Division, N.V.M.A., at Leeds.

April 28th.—Meeting of the Royal Counties Division, N.V.M.A., at the Laboratory of the Ministry of Agriculture and Fisheries, New Haw, Weybridge.

May 5th.—Meeting of the Mid-West and South Wales Division, at Bath.

May 10th.—Last day for nominations for election to Council, R.C.V.S.

May 24th.—R.C.V.S. Voting Papers and Annual Reports issued.

May 31st.—R.C.V.S. Council Election: last date for receipt of Voting Papers.

June 7th.—R.C.V.S. Annual General Meeting, 12 noon.

June 7th.—Annual General Meeting of Victoria Veterinary Benevolent Fund.

June 8th.—D.V.S.M. Examination begins.

Sept. 18th-23rd.—N.V.M.A. Congress, Llandudno.

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Veterinary Science at Cambridge

SCHEME OF CO-OPERATION WITH THE ROYAL COLLEGE

At the annual dinner of the Royal College of Veterinary Surgeons, which was held at the Hotel Victoria on Thursday of last week, and an extended report of which will appear in an early issue, the Vice-Chancellor of Cambridge University (Mr. W. Spens) announced an important scheme of co-operation between the University of Cambridge and the Royal College of Veterinary Surgeons. He said that they had had at Cambridge recently a committee or syndicate sitting on the relation of certain institutions to the University, and on their work. He had presided over that syndicate, and he was directed by them to take the present occasion to say something on certain conclusions reached.

"We are profoundly convinced," he said, "that in the case of any research institution it is important that it should also be engaged in advanced teaching. In our experience in other departments, participation in such teaching definitely assists the output of research rather than hinders it. We feel that such participation in teaching is the best method of securing an adequate and competent supply of research workers, and that that course affords the best method of drawing research institutions into the life of the University to the advantage of the institutions themselves.

"As a result the syndicate intend to propose to the University that they should establish a diploma of veterinary science. We do not intend to make any suggestion which would interfere in any way with the doctrine—which I understand is dear to this assembly—known as the 'one portal' to the profession. What the syndicate have in mind is that a candidate for the diploma should pass the first M.B. examination and that he should then take at Cambridge certain courses more particularly in physiology and pathology, which would supply a scientific training and background for his later work in veterinary science and which would qualify him for the B.A. degree and in due course for the M.A. degree.

"They contemplate that after that the candidate would proceed to a veterinary college and secure his M.R.C.V.S. and that finally he should return to Cambridge for a relatively short course of animal pathology. There are certain points in that scheme which will require careful consideration and discussion between the University and your College. If as we hope the University endorses our proposal in general principle we shall have to ask the Royal College to enter into discussions with us on the particular question as to how far the courses at Cambridge can be so adjusted as to make it possible to reduce the courses at the Veterinary College and perhaps to excuse some part of the examinations.

"It is clearly important that the students' course should not be unduly extended or overloaded. Much must depend from the point of view of a satisfactory result of the scheme on how the discussions go.

"It is now the settled policy of the University of Cambridge that our diplomas should only be given to our own graduates. On the other hand, it is by no means clear that this policy ought to be pursued, or could properly be pursued, when a new diploma is instituted, so as to exclude candidates who may wish to take that diploma, but have already started elsewhere on their studies. It seems to me to be a matter for consideration as to whether it might not be desirable that this diploma should for a period of years be open to all qualified members of the Royal College who have been through the ordinary course of study."

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PERSONAL

Mr. Justus Littler's Diamond Jubilee of Membership R.C.V.S.—On behalf of his fellow members of the profession, we extend hearty congratulations to Mr. Justus Littler, M.R.C.V.S., of Oakham, Rutland, who, on Monday next, celebrates his Diamond Jubilee as a member of the Royal College of Veterinary Surgeons.

XIIM

Mr. Littler, who was born in the Newark district, graduated at Edinburgh on April 17th, 1873, and has spent practically the whole of his long professional career at Oakham. His whole interest has centred in the practice of his profession. For many years he has officiated as Veterinary Surgeon to the Rutland Agricultural Society, and until a few years ago was one of the Inspectors for the County of Rutland.

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We would also offer our congratulations to Mrs. Thomas White, widow of Dr. White, for many years veterinary surgeon to the Denbighshire Yeomanry, who on Tuesday last celebrated her hundredth birthday at her home, Prince of Wales Cottage, Cynwyd, Merionethshire.

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Will.—Murray, Mr. Robert, of Rugeley, Staffs., veterinary surgeon (net personalty £6,625), £8,077.

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Retirement.—The retirement is announced of Dr. Charles John Reakes, the Director-General of Agriculture in New Zealand. He graduated in 1892 at the Royal Veterinary College in London, practised at Orpington, Kent, and entered the service of the New Zealand Government in 1901 as veterinary surgeon.

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R.C.V.S. OBITUARY

McGrath, Terence Tom, Edgecumbe, New Zealand. Graduated London, July 11th, 1924; died February 19th, 1933.

McGregor, John D., The Maid's Head, Old Catton, Norwich. Graduated Edinburgh, December 18th, 1888; died January 25th, 1933.

Scarlett, Herbert, Hastings, Sussex. Graduated London, December 20th, 1888; died January 14th, 1933, aged 68 years.

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The Late Mr. B. S. Cockerton, M.R.C.V.S.

In connection with the death of Mr. B. S. Cockerton, M.R.C.V.S., of Cambridge Heath, E.2, which was announced in our last issue, "A Friend" writes: "In the death of Mr. B. S. Cockerton, which occurred at his home, 57, King Edward's Road, South Hackney, there has passed a typical, sound veterinarian 'of the old school'—one of the old-time horse veterinary surgeons, in dress and manner. His outstanding attribute was a manly outspokenness and integrity which, despite a certain brusqueness, created a deep respect for him in the minds of all who met him, professionally or otherwise; moreover, his sharpness of manner concealed a nature essentially affectionate and genial.

"To him veterinary work was all in all: he had no other interest or hobby during the 35 years which elapsed since he came to London as assistant to the late Mr. Henry Shaw, whom he succeeded in practice."

Mr. Cockerton had been in failing health for the last two years and his death, though sudden, was not altogether unexpected.

The interment took place at Chingford Mount Cemetery on Wednesday, April 5th, in the presence of numerous friends and relatives, who included his uncle, Mr. Henry Sumner, senr., M.R.C.V.S., of Liverpool, and Mr. John Malone, M.R.C.V.S., who has been Mr. Cockerton's assistant for many years. Dr. James McCunn, a personal friend, attended and represented the Central Veterinary Society, of which the deceased gentleman was a Fellow.

THE GLASGOW CORPORATION STUD

The stud of 213 horses belonging to the Glasgow Corporation Cleansing Department is distributed over 11 stables throughout the city and suburbs, and without exception the horses are Clydesdale geldings of a superior class, ranging in height from 16·3 to 18·2 hands, and weighing between 16 and 20 cwts., or even more in some cases. "Many of them," says the *Scottish Farmer*, "have over seven years' service on the streets of the city, and it is a tribute to the breed and to the management of the stud that there is an absence of 'grease' and other similar troubles peculiar to draught horses doing heavy work. One veteran, aged 14 years, standing 18·1 hands high, and weighing exactly one ton, has been in regular employment for ten years. He has never missed a day's work or refused a meal during all that period; and his limbs and feet are as fresh and clean as those of any two-year-old. His case is not altogether exceptional, for the effective life of the horses on the streets often exceeds ten years, the average being about eight years. These facts must be kept in mind when assessing the relative merits of horse and mechanical haulage."

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The agricultural extension service of the College of Agriculture, University of Illinois, has recently issued a bulletin on Leukæmia of Fowls, which is a brief, practical presentation of the subject that will be helpful to veterinary practitioners and owners of fowls.

Correspondence

Letters to the Editor should reach the Office not later than by the first post on Tuesday morning for insertion in following Saturday's issue.

All correspondence must bear the name and address of the contributor for publication.

The Editor does not hold himself responsible for the opinions of his correspondents.

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PROSECUTIONS FOR ALLEGED CRUELTY TO ANIMALS

To the Editor of the Veterinary Record

Sir,—To my mind, it is unfortunate that Captain L. S. Balls, in his recent address at the "Central," did not name the veterinary surgeon who happened to be "against" him, in the case he cited, at the Croydon Police Court recently, as it places his fellow practitioner in a difficult position.

The features of the case are so very similar to a recent one in which I gave evidence for the prosecution, whilst Captain Balls acted for the defence, that I should be glad if you would allow me to give a resumé of my evidence, taken from my notes: "Seen half-an-hour after the horse had fallen. Aged bay cart gelding: very good bodily condition. Lame on off hind, with small wound on coronet. Found three large boils, and several small ones on the neck. Two of the large boils had broken and were raw and discharging. The animal evinced great pain on handling the neck.

"The top portion of the collar was bound together with thick cord, passing round from above to below. The three strands of cord, in contact with the neck, were nearly hidden by a mass of dried blood and dirt, which had been collecting for some days, at least. Quite obviously, the horse was in pain from this cord biting into his neck, already made tender by the presence of the boils. The collar was handed round the members of the Bench, who said they did not want to see any more, and convicted.

"There was no question whatever of the horse having to be destroyed."

Now, if this is the same case as that cited by Captain Balls, then it is quite apparent that his rendering of it was wholly incomplete and that he omitted what was, in reality, the leading and deciding factor—namely, the condition of the collar and the resultant pain and lesions.

Yours faithfully,

T. H. Michie.

41, Brighton Road,
Coulsdon,
Surrey.
April 3rd, 1933.

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To the Editor of the Veterinary Record

Sir,—I was very interested in the proceedings of the "Central," published in the *Veterinary Record* of April 1st. The position is very much the same in the country, or at any rate in this district, as in London.

The R.S.P.C.A. officer covers the ground of about twenty veterinary officers, and in ninety-nine cases out of a hundred, the same veterinary surgeon appears for the society, irrespective of distance; and he knows his power and uses it. In two instances that I know of, he killed horses where a veterinary surgeon was in attendance. I was in one case, but the owner was too poor to appeal. He also gave evidence in court of having made a careful *post-mortem* on two animals, and that there was no sign of worms in the intestines and not a blade of grass in the stomach. I had both animals exhumed, when I found the stomach of one not opened and the intestines of both intact and the stomach full of food. I called another veterinary surgeon to see them and open them with me. The veterinary surgeon appearing for the R.S.P.C.A. was reported to the R.C.V.S., and the answer I got was, in a polite way, "Be a good boy, agree with the veterinary surgeon, take your caning and all will be light."

This conduct is almost intolerable and the owners are poor, and it is my custom now, as I grow older and, I hope, wiser, to advise them to take their caning, as it is cheaper for them—but it is very unfair, and our own fault.

You cannot blame the society for taking the same man, as he suits their purpose to the ground. I must say this, that the society do good work in warning a great number of border cases.

Yours faithfully,

G. Jones Roberts, f.r.c.v.s.

Yoke House,
Pwllheli,
North Wales.
April 3rd, 1933.

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LETHAL CHAMBERS

To the Editor of the Veterinary Record

Sir,—I wish, with your permission, to approach the above subject from a fresh angle. Some of your correspondents have expressed or shown bewilderment concerning the objectives of the discussion and it seems to me that further progress will depend somewhat upon my ability to make clear these objectives.

The problem before us, if not manifold, is at least two-fold, of which the chief part has not yet been fully discussed. On the one hand there is for consideration the best means of effecting euthanasia to be taken in veterinary practice, the means to be taught in our schools, and the means to which research may be best directed. On the other hand, we have, I think, to seek and discover the best means for employment by the people; a fool-proof means, if there is such a thing. I suggest that it would be futile to go at the present time to Parliament with a request that all small-animal euthanasia should be handed over to the veterinary profession. This may be achieved in the future, but not yet. In the meantime, through sheer ignorance and for other equally difficult reasons of which we are well aware, dogs and cats are being tortured to death in great numbers every day by the people. It is all very well to talk about "sob stuff" and to sneer, but the torture of dogs through ignorance and prejudice and vested interest is a matter more fit for tears than many on which emotion is expended.

One might define the objectives in the discussion as follows:—

(1) What is or what are the best means to be adopted by veterinary surgeons in their practices for small-animal euthanasia? (2) Is it possible now, or in the near future, to take from the people the powers over animal life they have so sadly abused? (3) If this is not possible now, or in the near future, what is or are the best fool-proof means to be taken by the people and what means should be prohibited? (4) Having agreed upon the points in question (3), what steps should be taken to inform the people or what steps to prohibit undesirable means?

The discussion so far has shown us that more veterinary practitioners than formerly are interested scientifically or humanely in euthanasia, and it suggests that the profession as a whole may be relied upon to advance rapidly and surely to a point in knowledge and technique where suffering, either physical or mental, will be eliminated. But the discussion has not much helped the more pressing aspect of the question—the ignorance and the prejudice of the people. The people can use the coal-gas, all-glass lethal chamber, though they would do far better to devise a means of using pure carbon-monoxide diluted with air, say 5 per cent. CO and 95 per cent. air. The people, however, cannot use prussic acid, and the electro-lethaller without the prussic acid injection is believed not to be practicable or fool-proof. I am told that the R.S.P.C.A. tried and rejected the method on this account.

One correspondent tells us of chloral hydrate given by the mouth, and this suggests possibilities in the use of such drugs as nembutol, but can any slowly-acting poison given by the mouth be relied upon for dogs, which vomit so easily, and for cats that swallow with such reluctance? The people cannot inject chloroform into the trachea and they admit themselves that the chloroform box is a ghastly failure.

This, then, is the fresh angle from which the subject should be viewed if we are to derive full value from this discussion.

Yours faithfully,

J. Wakefield Rainey.

Burlington,
Newbury,
Berks.
April 3rd, 1933.

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"WHAT IS THIS SO-CALLED SEWAGE POISONING IN CATTLE?"

To the Editor of the Veterinary Record

Sir,—This is a purely veterinary question, in a veterinary periodical. I am asking the question and offering no opinion—sound or otherwise. So far, I have received two replies from Mr. Mayall, and I can leave it to your readers to decide for

themselves how far they have been an answer to my question.

In the first letter, Mr. Mayall makes the serious allegation that the veterinary profession in this country uses words to disguise thought, and then goes on to make reference to "Veterinary Pathology and Bacteriology," 1932, by Gaiger and Davies, to show how the *Bacillus typhosus* affects animals. I have not yet had an opportunity to consult this book, but have heard it rumoured that a perusal of it might show the authors of this text-book laying down that the *B. typhosus* (under its new name) is not the cause of naturally-occurring disease in animals!

In his second letter, again in reply to my question: "What is this So-called Sewage Poisoning in Cattle?"—I am told that my opinions are not too sound and that to be fair, and up-to-date, I ought to have a full acquaintance with "Veterinary Literature," and consult the experts on the matter.

Is this not precisely what I am doing? If Mr. Mayall is not one of the experts on the matter, may I ask him why he has taken it upon himself to reply to my question? Who are the experts on sewage poisoning, and in which text-book can I look for an up-to-date treatise on the subject?

My excuse for asking the question is that I know nothing about it, but I think I have the right to expect a different excuse on the part of those attempting to answer it.

Yours faithfully,

Thomas Lishman.

Common Room,
Gray's Inn.
April 10th, 1933.

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"SOME COMMENTS ON A RECENT OUTBREAK AMONGST PIT HORSES"

To the Editor of the Veterinary Record

Sir,—I really must protest against the assertion of Mr. W. M. Scott that I had treated two acute cases of catarrhal fever *cum* strangles with "bacterins."

I agree that if I had done so, my treatment would have been unscientific. As a matter of fact, my treatment was scientific, and perhaps rather too much up-to-date for Mr. Scott to appreciate.

Had Mr. Scott's memory been more retentive he would have remembered that my treatment was by a chemo-therapeutic method which had nothing to do with either "bacterins" ("A rose by any other name would smell as sweet"—whether American or English) or "auto-vaccines," and we should have been spared the long pedantic lecture as to what should or should not have been done under the circumstances.

I do wish Mr. Scott would restrain his too active superiority complex.

Unfortunately, I was unable to be present at the meeting as I am single-handed in a large practice, and it is not always easy to get away, much as I should like to do so—but I did the next best thing—I sent my contribution to the discussion.

I have the honour to be, Sir,

Your obedient servant,

J. W. Hall Masheter.

Ruddle House,
Newnham-on-Severn,
April 8th, 1933.

The Editor acknowledges, with thanks, the receipt of the following:—

Report of a meeting of the Midland Counties Division, N.V.M.A., from Mr. H. W. Dawes, Hon. Secretary. Report of a meeting of the Southern Counties Division, N.V.M.A., from Mr. G. N. Gould, junr., Hon. Secretary.

Communications from Mr. J. N. Bowen (Wolverhampton) and Miss D. Knight (Shinfield).

In last week's acknowledgments the address of Mr. H. Llewelyn Jones, of Denbigh, was erroneously given as Llanrwst.

Diseases of Animals Acts, 1894 to 1927
SUMMARY OF RETURNS

Period.	Anthrax.		Foot-and-Mouth Disease.		Parasitic Mange.		Sheep Scab.	Swine Fever.	
	Outbreaks confirmed.	Animals attacked.	Outbreaks confirmed.	Animals slaughtered as diseased or exposed to infection.	Outbreaks reported by the Local Authorities.	Animals attacked.	Outbreaks confirmed.	Outbreaks confirmed.	Swine slaughtered.
	No.	No.	No.	No.	No.	No.	No.	No.	No.
Period 16th to 31st March, 1933	16	17	7	653	10	16	7	49	21
Corresponding period in									
1932	22	22	—	—	2	2	11	88	39
1931	19	21	1	46	9	14	5	77	25
1930	26	27	—	—	12	15	6	115	51
Total 1st January to 31st March, 1933	107	126	54	5,161	68	128	172	246	89
Corresponding period in									
1932	117	146	1	67	60	106	106	537	232
1931	139	151	5	515	60	102	135	342	122
1930	130	136	—	—	97	147	226	644	253